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# REGIONAL FRUIT AND VEGETABLE PROCESSING INDUSTRIES IN WEST AFRICA

PREPARED FOR THE  
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

BY  
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CONSULTING ECONOMISTS  
WASHINGTON, D.C.

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## SUMMARY

Recommendations as to Feasibility

We recommend the active promotion of tomato paste and fruit juice processing and packaging industries because of the potential for import substitution and export sales of these products, and because of the regional character of the industries. A specific step which is recommended is the sponsorship of a preliminary feasibility study of three separate but interrelated industries:

- . Tomato and fruit processing plants, at inland locations suitable for tomato growing, producing tomato paste and tropical fruit juices (single-strength and concentrated) packaged in bulk for shipment to reprocessing/packaging plants;
- . Citrus fruit processing plants located in coastal regions of West Africa where citrus fruit is grown, producing concentrated citrus juices and essential oils for West African carbonated beverage bottlers and fruit juice packagers, and for markets in Europe and the Middle East;
- . Regional reprocessing/packaging plants centrally located in West African port cities and supplied with bulk-packaged tomato paste and fruit juice from the above two industries. The plants would package these products for West African consumers on a year-round basis and also ship concentrated juice from storage to foreign customers.

Further investigation, beginning with an analysis of export and local markets, would be required to establish the preliminary feasibility of these industries. Proposed Terms of Reference for such an analysis, which would be suitable



for presentation to interested investors in Africa, the United States, and Europe, are included.

We further recommend that priority attention be given to developing substitutes for wheat flour which could be used in proportions of up to 20 percent in baking. Such substitution could reduce the very large imports of wheat by as much as US\$78 million, based on 1981 imports. Considerable research and development has already been done on flour produced from cassava and plantains, as well as from other grains and tubers. A coordinated approach by West African states to speed development of this process could be sponsored by ECOWAS.

Research has also been done on the dehydration of vegetables, a process which offers possibilities for reducing the large losses caused by spoilage of perishable crops. Here also we recommend that ECOWAS assume the role of coordinator, and possibly of sponsor, of further research and development.

### Production of Fruits and Vegetables

A wide variety of fruit and vegetables is produced in West Africa. Most of this production is, however, grown in traditional fashion by smallholders and is too dispersed to serve as raw material for processing plants.

In this study, we are concerned with two of West Africa's major vegetation or climatic zones: (1) the tropical coastal zone, which supports almost all traditional African fruit and vegetables examined in this study, and (2) the drier inland zone, which is suitable for certain types of fruit and European-type vegetables, such as tomatoes. The latter are grown wherever water is available for irrigation.

In a number of countries, particularly the French-speaking ones, the state intervenes by organizing farmers into cooperatives and establishing them on developed tracts of land where technical assistance and farm inputs are made available. This applies mainly to vegetable market gardens or truck farms where higher value European-type vegetables are grown for sale in large urban areas. Assistance is also given to fruit grower cooperatives, as in the Ivory Coast.

The most highly organized form of production is associated with the agro-industrial complexes. This system functions well when the farm either is operated directly by the processor or is closely linked through a cooperative to the processing facility, sometimes by common management or ownership.

#### Status of Fruit and Vegetable Processing

Existing fruit and vegetable processing plants in West Africa consist mainly of (1) tomato paste plants, in some cases also producing mango juice, (2) pineapple processing plants producing canned slices and juice, (3) fruit juice plants, primarily processing citrus fruit, and (4) plants producing citrus oils and concentrated citrus juices.

Tomato paste processing plants are producing for local sale (import substitution) and are high-cost operations compared to imported paste. Their success is strongly influenced by the degree of protection they enjoy from imports. Much of the high cost derives from the fact that the processing plants -- located in interior areas remote from the coast -- either import cans, or import tinplate to make their own cans. Four plants are now operating. Those which do not directly control their source of supply of

tomatoes are experiencing difficulty in getting enough supplies to operate at profitable levels.

Pineapple processing plants produce primarily for export to Europe (and to a lesser degree to West African countries). They are being badly hurt by lower cost products from Asia in the European markets. The reason for this cost disadvantage relative to Asian products has to do with the higher shipping costs from Africa, higher labor costs, and higher costs for such supplies as sugar and containers.

Concentrated citrus juices and citrus oil plants, exporting to Europe, are relatively successful at present after several years of poor markets. The market for special citrus oils, such as bergamot and bigarade oil, upon which these plants depend does not appear to offer as favorable growth prospects as that for juice products.

Fruit juice plants, those producing concentrated or single-strength (full-strength) juices for local sale, including citrus, mango, and other products such as jams, have had mixed success. Because of the lack of organized local production, many depend on imported juice, which is subject to interruption due to economic conditions.

#### Markets for Processed Fruits and Vegetables

West African markets exist for processed tomato paste and fruit juice products. Tomato paste is especially important as it has in recent years become a widely consumed item. Current demand for the ECOWAS region is estimated at 59,000 tons. The four plants now operating are producing only 7,400 tons of paste annually, but could produce 15,000

tons if operated at capacity. Another 1,400 tons will be produced in Benin once a plant already built there goes into operation. The status of a reported four additional non-operating plants in Nigeria and Ghana is unknown. Without taking these into account, additional capacity of 43,000 tons is required to satisfy West African demand. This is equivalent to roughly 10 plants of 4,000-ton capacity, similar to those now operating. Currently planned projects in a number of countries would add 30,000 tons of additional paste if implemented.

In contrast to demand for tomato paste, West African demand for fruit juice is relatively weak but growing. The market is twofold: that for products used in making flavor concentrates for carbonated beverages, and that for pure fruit juices. Virtually all flavor concentrates used by soft drink bottlers in West Africa are now imported. Based on current consumption data, we estimate an annual demand for 267,000 liters of 60° Brix concentrated orange juice, 1.26 tons of orange oil for orange drinks, and 89,000 liters of concentrated lemon juice plus 84 tons of lemon and lime oil for lemon-lime drinks.

Fruit juice demand is estimated (primarily on the basis of import data) at 13,000 tons annually for ECOWAS. It consists mainly of citrus juices (predominantly orange) and lesser amounts of pineapple and temperate-climate juices such as apple and black currant juice. Demand is low due to the almost year-round availability of fresh fruit such as oranges and the high price of imported juices (bought almost exclusively by urban dwellers).

The European market offers good prospects for sales of tropical fruit juices such as passion fruit. There is a sizable demand in Middle Eastern countries for all kinds of tropical fruit juices, especially mango.

## INTRODUCTION

### Study Terms of Reference

The contract between the U.S. Agency for International Development and Robert R. Nathan Associates, under which this work was carried out, states that "the objective of this activity is to assist ECOWAS (the Economic Community of West African States) in determining the feasibility of regional food processing industries within West Africa." The industries concerned were identified as fruit and vegetable processing industries. Initially, 5 of the 16 ECOWAS countries were to be surveyed: the Ivory Coast, Nigeria, Sénégal, Sierra Leone, and Benin. Later, during the course of the work, two other countries were added: Guinea and Mauritania.

Under the study terms of reference, the consultant was to:

- . Determine the location, characteristics, and performance of existing production units, and identify derivatives of fruits and vegetables which would lend themselves to processing in West Africa.
- . Estimate the magnitude of investment needed to establish new plants or to convert existing plants into profitable production units, including estimates of the volume of raw material inputs required.
- . Estimate the magnitude of domestic, regional, and overseas markets for locally produced and processed products.
- . Recommend follow-on action to stimulate private (local or U.S.) investment in such industries.

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### Conduct of the Work

Field work was carried out by the consultant in West Africa from November 1 to December 16, 1982. In addition, two days of preparation time were spent in Washington prior to his departure for West Africa, and one day of debriefing was conducted upon his return. A briefing on preliminary findings of the study was held for ECOWAS and USAID officials in Lagos on December 16.

The consultant was ably assisted in the field work by an Ivorian agricultural specialist, M. Koffi Kouadio, who was under contract to USAID/REDSO in Abidjan. M. Koffi was primarily responsible for those sections of the report dealing with agricultural production. The study benefited from his experience and knowledge of African agriculture.

The report was prepared in the United States by the consultant in January and February 1983, and includes material sent from Africa by the Ivorian specialist.

### Structure of the Report

The report is divided into two parts, plus appendices. Part I of the report contains our findings. It is composed of sections dealing with current production of fruit and vegetables, existing processing facilities, market demand and supply, our findings as to the feasibility of certain industries, and, finally, our recommendations to ECOWAS on the next steps which should be taken.

Reports on our surveys of individual countries, which serve as background for our findings, constitute Part II of the report. Some of the information included in Part II was

not used in drafting our findings, but may be useful as source material for the work to follow.

Appendix A includes a series of profiles on existing processing plants which we feel are useful illustrations of the current state of affairs. In Appendix B, we include some observations on the present level of trade among ECOWAS countries, some current obstacles to increased trade, and prospects for the future. Appendix C lists the people we contacted during the course of this study, and Appendix D provides a bibliography.

Although our field work covered only 7 of the 16 ECOWAS member countries, we have endeavored to extend our findings, whenever possible, to the entire ECOWAS region.

#### Acknowledgments

We wish to acknowledge the invaluable assistance of members of the ECOWAS staff, especially Mr. J.E.A. Manu, Mr. Y. Sow, and Mr. Frank Ofei. We are also grateful for the guidance we received from senior ECOWAS officials, especially Dr. Aboubacar Diaby-Outana, Executive Secretary, and Dr. D.T. Sakho, Assistant Executive Secretary. At USAID/REDSO we received continuing support and assistance from Mr. Ronald Rogers. Finally, we acknowledge the cooperation of numerous officials of government agencies in the countries we visited, as well as that of the private businessmen who provided information to us.

**PART I**  
**REGIONAL OVERVIEW**



## A. PRODUCTION OF FRUITS AND VEGETABLES

### Introduction

In most ECOWAS member countries, fruit and vegetable crops are primarily produced by individual farmers for subsistence purposes, i.e., little production is commercialized. In consequence, production statistics tend to be unreliable or unavailable. Exceptions to this are the large plantations growing pineapples and bananas for fresh export, and the tomato farms and citrus plantations which are part of agro-industrial complexes. Fairly reliable information on production is available from these sources. Such data as are available are reviewed and analyzed in the subsection below entitled "Production Levels."

As regards the organization of production, in most areas the government has a major organizing and supporting role, often reaching farmer-producers via cooperatives. These systems are reviewed and summarized below, and are discussed in some detail in the individual country reports contained in Part II of this study.

It should be pointed out that information on the current production of fruit and vegetables in West Africa is relevant to this study only insofar as it indicates the types of crops that are now being grown, the conditions under which they are being grown, and the areas that are suitable for various types of crops. Any industry processing fruit or vegetables that might be established pursuant to this report would need to establish new farms or orchards closely linked to the processing facility. In very few cases will existing production be available to the processor, as it will be

found that producers are too dispersed, crop varieties are unsuitable, or the organizational structure is inappropriate.

### Types of Fruit and Vegetables Produced

The types of fruit and vegetables produced in various parts of West Africa are determined mainly by climatic factors. Exhibit I-1 indicates the region's three major vegetation zones: the lowland rain forest, the wooded grassland belt, and the semi-desert area. Only the first two of these zones are relevant to our study.

### Fruits

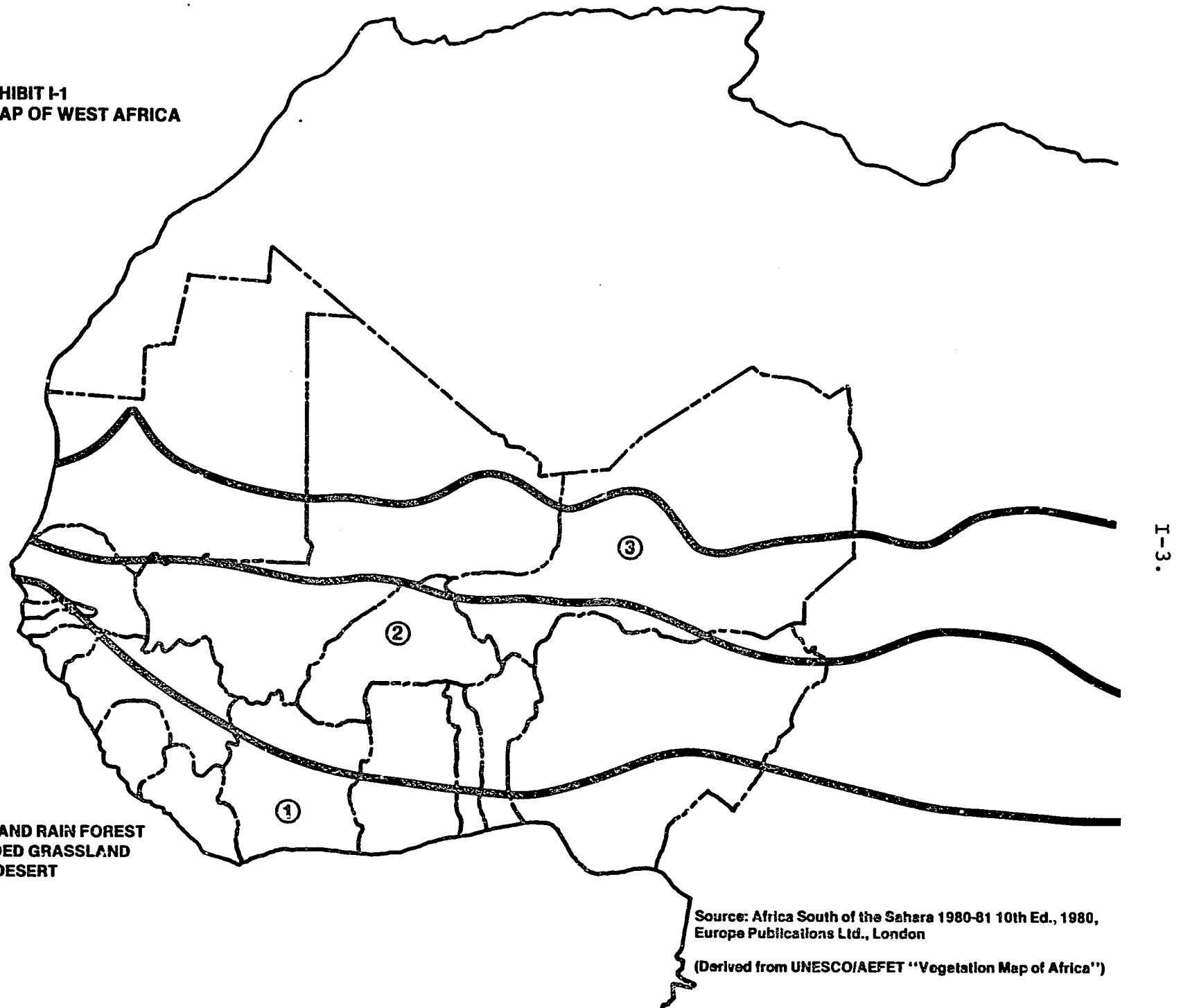
The greatest variety of fruit is grown in the tropical coastal or lowland areas of West Africa. The drier inland (wooded grassland) regions of the Sahel are unsuitable for many types of fruit, such as pineapple, bananas, and citrus, although others such as papaya and mango can be grown there.

The principal fruits grown in West Africa are:

- . Pineapple - Grown mainly on commercial plantations, but also by smallholders. Exported fresh and in processed form.
- . Citrus - Widely grown in the coastal belt by smallholders, although a few commercial plantations exist. Includes oranges, lemons, limes, tangerines, grapefruit, and special fruit such as bergamot and bigarade processed for essential oil. Very little citrus fruit is being processed as yet.
- . Banana - Grown in tropical coastal areas, especially on commercial plantations in the Ivory Coast and to a lesser extent in Guinea. Also grown by farmer cooperatives which sell to exporters, and by individual farmers for fresh market sale.

**EXHIBIT I-1  
VEGETATION MAP OF WEST AFRICA**

**ZONE 1: LOWLAND RAIN FOREST  
ZONE 2: WOODED GRASSLAND  
ZONE 3: SEMI-DESERT**



Source: Africa South of the Sahara 1980-81 10th Ed., 1980,  
Europe Publications Ltd., London

(Derived from UNESCO/AEFET "Vegetation Map of Africa")

- . Plantain - Grown in the same areas as banana, but only for local market sale and subsistence. No commercial plantations exist, and no processing is being done.
- . Mango - Grown almost everywhere in West Africa on a small scale, in both coastal and inland areas. A few orchards of better-quality grafted mangoes exist in Guinea and the Ivory Coast. Some juice is being processed in the Ivory Coast, Nigeria, and Benin.
- . Papaya - Widely grown, but not on a commercial scale. No processing is taking place.
- . Passion fruit - A new commercial crop for West Africa. Some plantings have been done in the Ivory Coast and in Sierra Leone.

### Vegetables

A distinction is usually made between market garden crops (produits maraîchers) and industrially grown crops.

#### Market Garden Crops

Market garden crops include both traditional African and European-type vegetables. African vegetables consist of:

- . Eggplants;
- . Okra (gombo);
- . Pimento;
- . Sweet peppers; and
- . Sweet potatoes.

Tubers -- cassava, yams (or igname) -- are not normally included in the vegetable category, nor are legumes such as cow peas or chick peas.

European vegetables include:

- . Tomatoes;
- . Potatoes;
- . Onions;
- . Cabbages;
- . Green beans;
- . Carrots;
- . Peas;
- . Squash;
- . Melons;
- . Lettuce;
- . Radishes; and
- . Cucumbers.

The traditional African vegetables are grown by every rural household, and any surplus over the household's needs are marketed for cash. The European vegetables, surprisingly diverse, are grown near the large cities where markets exist for these more costly crops.

None of these vegetables, other than tomatoes (discussed below), is now being processed. African vegetables are cheaply produced, and most are widely available; there would be no market for them in their more expensive processed form.

Some European vegetables are being imported in processed form for consumption by urban dwellers. The market for such products as canned peas or beans is too small to justify local processing, and the locally processed products would in any case be much higher in price than imports.

Fairly large amounts of potatoes and onions are being imported from Europe. As yet, research on potato growing has not produced successful results. Certain varieties of

onions, on the other hand, do well under West African conditions. Research is being carried out on the drying of onions using simple wooden sheds with shelves developed in Sénégal.

#### Agro-Industrial Crops

Tomatoes are the only vegetable crop that currently falls within the category of agro-industrial crops. Tomatoes are grown specifically for the production of tomato paste in several West African countries, and many similar projects are in the planning stage. At least 10,000 hectares (ha) of tomatoes are now being grown on irrigated farms in the dry inland areas of Nigeria, Benin, the Ivory Coast, and Sénégal. Although these tomatoes are primarily processing varieties rather than fresh market varieties, a part of the fresh production finds its way into local markets.

#### Production Levels

Production statistics for West Africa compiled by the Food and Agriculture Organization are given in Exhibit I-2 and show wide variations among ECOWAS states. These differentials are diminished when the figures are converted to a per capita basis. Since these figures represent predominantly subsistence production, they can be expected to correlate rather closely with population figures. Given the unreliability of most data on subsistence crops, one should not place too much reliance on these figures. However, a few generalizations can be made.

Vegetable production in West Africa is centered in the coastal states in the tropical belt from Guinea to Nigeria. The southern parts of Mali, Upper Volta, and Niger, where

Exhibit I-2. Fruit and Vegetable  
Production by ECOWAS Member Countries, 1981

Country	Production (000 tons)		Per capita production (kg)	
	Vegetables and melons	Fruit (except melons)		
			Veg.	Fruit
Benin	137	60	38	16
Cape Verde	6	15	19	47
Gambia	7	4	11	6
Ghana	550	1,003	46	83
Guinea	380	527	59	82
Guinea Bissau	20	40	24	48
Ivory Coast	305	1,428	37	172
Liberia	64	121	31	59
Mali	135	10	80	1
Mauritania	6	17	4	10
Niger	134	38	24	7
Nigeria	3,283	3,200	41	40
Sénégal	87	79	14	14
Sierra Leone	159	129	45	36
Togo	66	43	24	16
Upper Volta	70	58	10	8

Source: Food and Agriculture Organization, FAO Production Yearbook, 1981. Per capita figures derived using population statistics in the International Monetary Fund's 1982 Yearbook.

water is available, are also important producers of vegetables. The dry climate states, such as Sénégal and Mauritania, are smaller producers because of the limited amount of water available for irrigation.

Fresh vegetables such as sweet peppers, green beans, tomatoes, and pimento have in fact been exported by air to Europe from Mali, Upper Volta, Sénégal, and Niger. Increasing local demand and poor air service has reduced these exports in recent years. A large American concern, BUD-Sénégal, exported as much as 10,000 tons to Europe by air from Sénégal before the company's liquidation in 1979.

As to fruit, the Ivory Coast is a large producer, especially relative to the size of its population, due to the extensive plantations that grow pineapples and bananas for export. Production in Ghana and Guinea also includes some exports. Other states are mainly subsistence producers. Sierra Leone, Liberia, Nigeria, Guinea Bissau, and Cape Verde are sizable producers on a per capita basis. At the low end of the scale are all the drier climate states, such as Sénégal, Gambia, Mauritania, Mali, Upper Volta, and Niger. Fruit orchards are generally not irrigated and so depend on rainfall alone, in contrast to intensively cultivated vegetables which cover smaller areas and can be concentrated near watercourses.

#### Organization of Production

Production of fruit and vegetables may be viewed in terms of three distinct sectors: the traditional, the modern, and the agro-industrial.



The traditional sector is composed of small farmers who raise fruit and vegetables for their own consumption and who market locally any surplus they manage to produce. Virtually all of the typical African fruit and vegetables one sees in the markets come from this source. Few modern inputs, such as chemical fertilizers and sprays or improved seeds, are used to produce these crops.

The modern sector, on the other hand, consists of developed areas of up to several hundred hectares where farmers receive technical assistance and such inputs as credit, equipment (sprayers and hand tools), chemicals, and improved seed. The higher value European-type vegetables are commonly grown on these plots. Some fruit grower cooperatives, such as banana growers in the Ivory Coast, also fall into this category.

The agro-industrial sector is made up of fruit or vegetable production areas linked to processing plants. These production areas may be in the form of company-owned farms, but more commonly consist of grower cooperatives which receive technical assistance and inputs through the processor (either a state or private enterprise) and deliver their produce to the processor under some kind of contractual arrangement.

The most highly developed structure is seen in the French-speaking countries. The Ivory Coast, Sénégal, Benin, and Guinea -- among the countries we visited -- have rather elaborate systems for organizing production with state intervention. In the Ivory Coast, for example, the state (through various specialized organizations) supports:

- . Small urban market gardens (petits périmètres urbains) of 1 to 20 ha, which are provided with irrigation water and inputs and where the work is carried out by families organized into village cooperatives for marketing of their products.
- . Large market gardens or truck farms (grands ensembles maraîchers) consisting of areas of 100 to 200 ha, where African and European-type vegetables are grown intensively. The state develops the land and provides irrigation water; the area is divided into blocks assigned to farmers grouped into cooperatives.
- . Agro-industrial areas, such as those which supply tomatoes to the state-owned Sinématiali tomato processing plant. A government agency took complete responsibility for developing the 1,800 ha Sinématiali farm, provides and maintains all farm equipment, settled groups of farmers on the land, and assigned them to work 180 ha blocks of land.

Descriptions of these various systems will be found in the country reports in Part II of this study.

### Summary

A wide variety of fruit and vegetables is produced in West Africa. Most of this production is, however, grown in traditional fashion by smallholders and is too dispersed to serve as raw material for processing plants.

In this study, we are concerned with two of West Africa's major vegetation or climatic zones: (1) the tropical coastal zone, which supports almost all traditional African fruit and vegetables examined in this study; and (2) the drier inland zone suitable for certain types of fruit and European-type vegetables, such as tomatoes. The latter are grown wherever water is available for irrigation.

In a number of countries, particularly the French-speaking ones, the state intervenes by organizing farmers into cooperatives and establishing them on developed tracts of land where technical assistance and farm inputs are made available. This applies mainly to vegetable market gardens or truck farms where higher value European-type vegetables are grown for sale in large urban areas. Assistance is also given to fruit grower cooperatives, as in the Ivory Coast.

The most highly organized form of production is associated with the agro-industrial complexes. This system functions well when the farm either is operated directly by the processor, or is closely linked through a cooperative to the processing facility, sometimes by common management or ownership.

## B. STATUS OF FRUIT AND VEGETABLE PROCESSING

### Situation in General

Existing fruit and vegetable processing industries in the seven West African countries surveyed are listed in Exhibit I-3. Of the 19 plants listed, only 5 are known to be operating with some success. Of the remainder, two are still in the start-up phase; two are suffering financial problems and have received government subsidies to remain in operation; four are operating at less than 50 percent capacity; and four are not operating. No information was available on the remaining two plants.

The location of these plants is shown on the accompanying map (Exhibit I-4). Included are three plants reported to exist in Ghana, and one each in Mali and Niger, which are not part of our analysis.

As to type of process, the 19 units can be broken down as follows:

- . Tomato paste, with or without mango or other juices -- six plants;
- . Pineapple juice and slices -- three plants;
- . Citrus juice and citrus oils or oil only -- three plants;
- . Citrus juice and other fruit juices -- six plants; and
- . Multiproduct (pineapple, mango, citrus juice and oil) -- one plant.

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**Exhibit I-3. Existing West African Fruit  
and Vegetable Processors**

Country and location	Name/ ownership	Start of operations	Products	Production, 1981/82	Source of raw material	Markets	Status
<b>Benin</b>							
Natitingou	SONAFEL (State)	1980/1981	Tomato paste, mango juice	60 tons of tomato paste	SONAFEL- managed plantation	Local	Operating at low levels - technical problems
Halatia	SONAFEL (State)	Built 1978, not operat- ing	Citrus juice, citrus oils	None	SONAFEL plantations	Export	Not operating due to equip- ment problems
<b>Guinea</b>							
Forécariah	SALGUIDIA (Guinean and Libyan Govts.)	1982	Pineapple slices and juice, citrus juice	Pineapple juice only (42,000 cases)	Company plantation plus local farmer coops	Export and local	Still in start- up phase; full range of pro- ducts to be produced in 1983
Kankan	Guinea Govt.	-	Fruit juices (orange, grapefruit, mango, papaya)	Unknown	Local purchases	Export and local	Unknown
Labé	SIPAR	-	Oil of berga- mot, bigarade, lemon	Unknown	Own plan- tation plus local pur- chase	Export to Europe	Operating - no details avail- able
Mamou	Conserverie de Mamou (State)	1960's	Orange juice, tomato juice, jams	None	Local purchase	Export and local	Shut down - renovation planned

(Continued)

## Exhibit I-3 (Continued).

Country and location	Name/ownership	Start of operations	Products	Production, 1981/82	Source of raw material	Markets	Status
<u>Ivory Coast</u>							
Sinematiali	SODEFEL (State)	1979	Tomato paste, mango juice	1,400 tons of tomato paste; small amt. of mango juice	Coop. farm managed by SODEFEL	Local	Operating at about 35% of capacity, 50% projected for 1983; tomato production increasing
Tiassale	SAFCO (Private)		Pineapple slices and juice	Processed 15,200 tons of fruit	Company plantation, 25%; local farmers, 75%	Slices: 90% Europe, 10% W. Africa; juice: 25% Eur., 35% W. Af., 40% local	Operating but sales down due to Asian competition in Europe
Ono	SALCI (Mixed state/private)		Pineapple slices and juice	Unknown	Company plantation, 30%; local farmers aided by SODEFEL, 70%	Export to Europe and local	Temporarily shut down, operations planned for 1983; export sales down
Bonoua	Nouvelle SIACA (Private)		Pineapple slices and juice	Unknown	Local cooperative	Export to Europe and local	Plant closed due to financial problems

(Continued)

Exhibit I-3 (Continued).

Country and location	Name/ ownership	Start of operations	Products	Production, 1981/82	Source of raw material	Markets	Status
<u>Ivory Coast (Cont.)</u>							
Sassandra	COCI (Coop. of growers and European firms)	1979	Lemon juice/ oil; oil of bergamot & bigarade	122 tons of essential oils, 1,100 tons of juice	Coop. of growers (COPAGRUM)	Export to Europe (fruit drink, confectionery, & cosmetic industries)	Operating at less than capacity, but raw mat'l supplies increasing
<u>Nigeria</u>							
Near Gombe	VEG-FRU (private)	1976	Tomato paste, mango juice, tomato juice	4,500 tons paste, plus small tonnage of others	Own farm, 50%; outside purchases, 50%	Local	Operating - expanding; (also producing other fruit juices in Lagos)
Ibadan	Kole James & Co. (Ago-Taylor)	-	Orange & lemon fruit drinks	Unknown	Outside purchases	Local	Operating at low level (competition from soft drinks)
Ibadan	Lafia	-	Canned orange & mango juice	Unknown	Unknown	Local	-

(Continued)

## Exhibit I-3 (Continued).

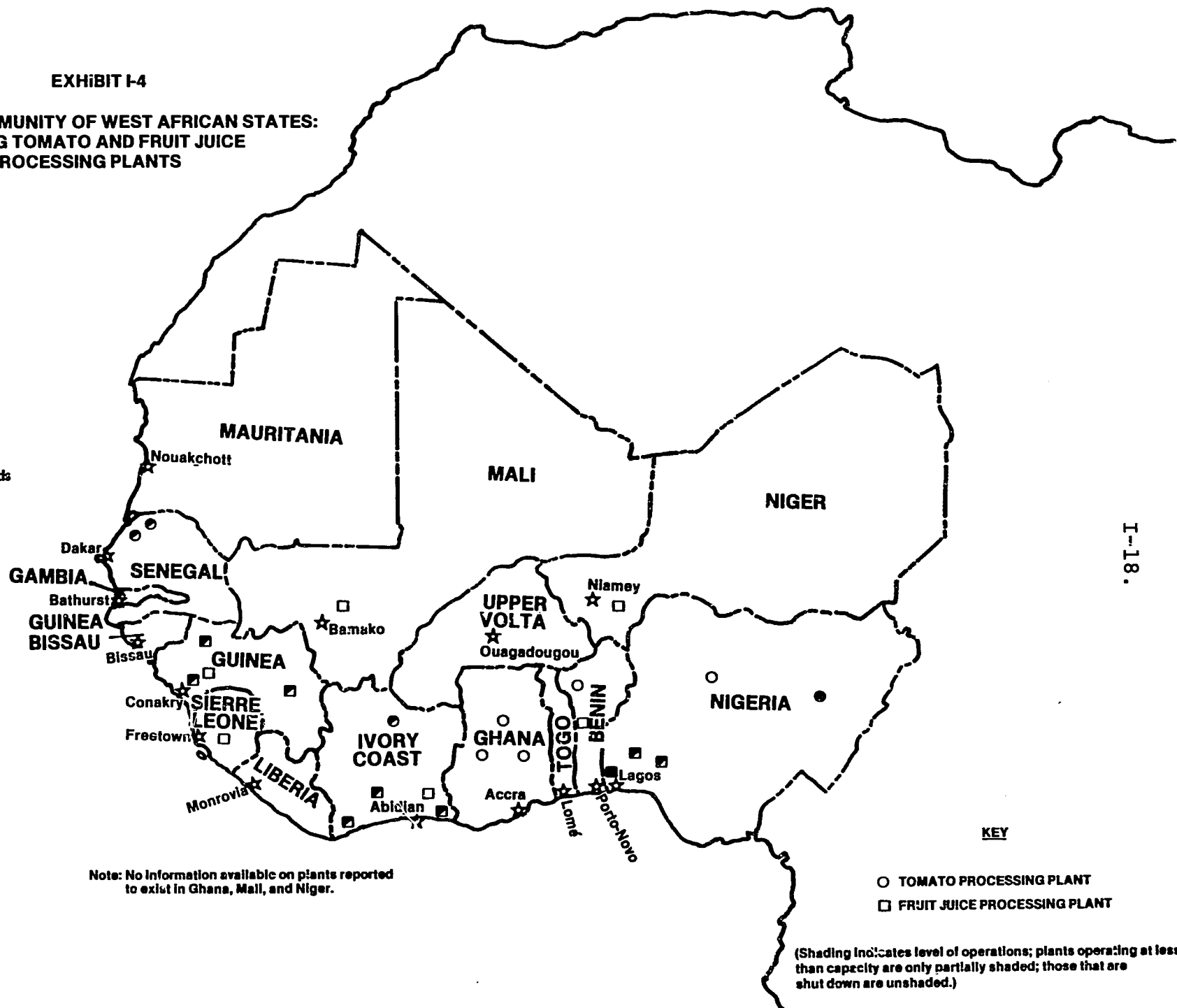
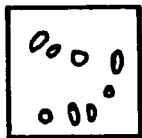
Country and location	Name/ownership	Start of operations	Products	Production, 1981/82	Source of raw material	Markets	Status
<u>Nigeria (Cont.)</u>							
Lagos	Tre-Top (Lever Bros.)	-	Bottled fruit juices: orange, lemon, lime, pineapple, black currant	600 tons	Imported single-strength juices	Local	Expanding
Zaria & Ikeja	Cadbury-Fry		Tomato sauce (spiced)	None	Purchases in Kano area	Local	Shut down - raw material problems
<u>Sénégal</u>							
Dagana	SNTI (State)	1979	Tomato paste	Approx. 800 tons of paste	Cooperative farm managed by SAED (state)	Local	Operating at less than 50% capacity - raw mat'l problems
Savoigne	SOCAS (private)	Before 1977	Tomato paste	Approx. 800 tons of paste in 1978/79	Company plantation (less than 50%). Purchases from farmers & SAED project (balance)	Local	Operating at less than capacity - raw mat'l problems
<u>Sierra Leone</u>							
Mabole	Mabole Fruit Co. (Sierra Leone/Dutch Govts.)	1978	Fruit juices (mainly orange) Jams	None	Local farmers	Local	Shut down in 1980 - technical problems



EXHIBIT I-4

ECONOMIC COMMUNITY OF WEST AFRICAN STATES:  
EXISTING TOMATO AND FRUIT JUICE  
PROCESSING PLANTS

Cape Verde Islands



The principal features of these plants are discussed in the following subsections.

#### Tomato Processing

The development of tomato paste production in West Africa has taken place mainly during the past 5 years. Nigeria, the Ivory Coast, and Sénégal have established plants during this period, and one in Benin may be operating within the next year. All these units are located in the dry island zone, away from tropical coastlands, and are associated with irrigated farms.

Processing plants are all equipped with Italian machinery, most of it modern and in good condition. Few technical problems are being experienced with processing or canning of the product. The plants are integrated or self-contained in that they both process and package the final product, and therefore have to import cans already made or make their own. The cost of these cans and of the whole packaging process -- can filling, closing, labeling, and packaging in cartons -- accounts for a major share of both initial plant investment cost and operating costs. Low utilization of this machinery caused by short processing seasons, not to mention periodic problems with raw material supply, lead to a high-cost product.

Tomato production comes from adjacent irrigated farms, either company-owned or grower cooperatives set up with government assistance. The technical problems of growing tomatoes in these areas have generally been surmounted. Yields are typically on the order of 20 tons/ha, although on an Ivory Coast project they are expected to reach 28 to 30 tons/ha next season. A 3-year crop rotation is normally

practiced, with the land being left fallow or planted to grains in alternate years.

In general, the tomato processing plants are experiencing difficulties in obtaining a sure source of supply. Production is below that needed for the plants to operate at capacity. Due to market demand for the fresh product, farmers can obtain better prices for their tomatoes on the open markets. The most successful ventures are those where the processor directly controls crop production to the extent of a major share of his needs.

Current production and estimated plant capacities are compared below for the four known units now operating (excluding the one in Benin, which is still in the start-up phase):

	Current production (tons)	Estimated production capacity (tons)
Ivory Coast	1,400	4,000
Nigeria	4,500	5,000
Sénégal (2 plants)	<u>1,500</u>	<u>6,000</u>
Total	7,400	15,000

Tomato paste is 28 percent concentrate packed in 70 gram (gm) cans for local consumption. Production costs are high: ex-factory prices are two to three times the landed cost of paste from Italy. (As these imported products are subsidized, the real differential is probably a factor of 1.5 to 2.) Tariffs, taxes, and handling costs on imports bring the products to roughly the same retail price in both

Nigeria and the Ivory Coast. Where smuggling is prevalent, as in Nigeria, Italian paste might sell for half the price of the local product and strongly affect sales.

What is the reason for the large cost difference, and what are the prospects for closing the gap? High costs are associated with:

- . The location of these inland plants at long distances from ports and urban consuming areas, which increases costs and delivery times of such supplies as cans and of final products, especially where roads are poor;
- . The inherently expensive process of establishing farms in these remote areas, including not only land clearing and preparation but construction of dams and water distribution facilities, access roads, equipment maintenance shops, and even complete villages for the farmer cooperatives which will work the land;
- . The low per hectare yields of tomatoes, which are still well below those in the United States and even Europe (yields in West Africa average 20 to 25 tons/ha on commercial farms, although 40 tons/ha have been achieved on small plots; in California, yields average 75 tons/ha);
- . The high cost of expatriate managers and technicians; and
- . The high cost of importing fully made cans, or the high cost of manufacturing cans locally from imported steel.

There is little to be done about the second point, the location of irrigated farms in the interior of the countries. This will remain costly, although improved transportation links and more trained people will help to alleviate the problems. Several other points are, however, susceptible of improvement: better roads in some countries will reduce

transport costs for plant supplies and final products, tomato yields can be increased, and expatriate managers will be phased out as more trained people become available locally. However, the cost of cans will remain high until tinplate is produced in Africa. A possibility to be investigated is the use of plastic tubes in place of cans.

The importance of tomato paste processing lies in its potential for substitution of very sizable imports of tomato paste throughout West Africa. At present only a fraction of demand is being met by local processors -- less than 20 percent for the region as a whole. As will be discussed in Section D ("Feasibility of Regional Food Processing Industries"), there is definite potential for expansion of this industry.

A description of the various tomato processing projects is given in the country reports in Part II; detailed profiles of one plant in the Ivory Coast and one in Nigeria appear in Appendix A.

Ghana was not included in our survey, but a 1974 study on vegetable production and processing in Africa reported that three tomato concentrate plants existed in Ghana at that time. However, two of them were closed and the third was producing only a small quantity of tomato juice. The reason for this state of affairs was reported to be the lack of a supply of tomatoes. Apparently the plants never operated at more than 29 percent of capacity.

#### Pineapple Processing

Only the Ivory Coast and Guinea among the countries surveyed are presently processors of pineapple. The plant

in Guinea is a multiproduct plant, and is discussed subsequently under that heading. In the Ivory Coast, there are three pineapple processors, all of which rely heavily on exports to Europe and are being hurt by lower priced product from Thailand, Malaysia, and the Philippines. For several years all three received government subsidies. One plant has ceased operations; a second shut down temporarily in 1982, but is scheduled to start up again in 1983. The third is operating but sales remain substantially below normal.

It is useful to examine the reasons for the high production cost of these operations, since it is relevant for other industries as well. Recent data obtained by SODEFEL<sup>1</sup> permit a comparison of cost data (in CFA francs) in the Ivory Coast with those in three Asian countries:

	Packaging cost/ <u>24 cans</u>	Transport cost/m <sup>3</sup> C.I.F. <u>Europe</u>	Labor cost/ <u>24 cans</u>	Raw mat'l cost/ton
Malaysia	435	1,240	142	9,400
Indonesia	473	1,589	90	8,600
Thailand	388	1,425	26	12,900
Ivory Coast	526	1,450	220	15,000

The result is that Thai canned pineapple can be delivered in Europe for CFA 80/can of 580 gm, while the Ivory Coast product costs CFA 101, or 26 percent higher. One reason for the cost differential is the striking

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1. Reported in an ILO working paper by Rudy Maex and Alan Read entitled A Comparative Analysis of Local Processing for Export in Niger and the Ivory Coast, WEP 2-36/WP 16, May 1982.

difference in labor costs, which is due primarily to much lower wage rates in Asia than in the Ivory Coast. It is also probable that the newer processing plants, such as those in Thailand, are equipped with more efficient machinery.

One would expect that relative transport costs would give the Ivory Coast an advantage in Europe over Asian producers. However, Asian producers reportedly benefit from nonconference shippers who give 40 to 50 percent price breaks. Even the conference rates in Asia are relatively lower on a ton-mile basis than those for African lines.

Container costs also favor Asian producers. In 1978, a No. 2 can cost CFA 16.15 in Thailand and CFA 21.92 in the Ivory Coast. Further study is required to determine the reasons for this cost differential.

Raw material costs are also higher in the Ivory Coast than in Asia, probably due to the higher costs of agricultural inputs (fertilizer, chemicals) and higher labor costs for field workers.

Even such supplies as sugar are more costly in the Ivory Coast, where processors are required to use locally produced sugar, which is higher priced than imported sugar.

In summary, numerous factors are at work to render Ivory Coast pineapple noncompetitive in Europe: higher labor costs, which affect the cost of fruit production as well as canning; higher transportation costs for raw materials and finished products; and probably more efficient processing machinery. The near-term prospects for pineapple processing in West Africa for export are therefore not promising.

The situation is different in Guinea, where the new processing plant being started up is a joint Guinea/Libyan Government venture. Libya is expected to take a major share of the canned slices and juice at prices agreed upon in advance. Juice will also be available for export to other West African countries. This enterprise, known as SALGUIDIA, is interesting in that it is the only plant to combine pineapple, citrus, and mango processing.

Further information on these plants will be found in Part II in the sections on Guinea and the Ivory Coast. Profiles on SAFCO and SALGUIDIA appear in Appendix A.

#### Citrus Juice and Citrus Oil Processing

One citrus juice and citrus oil processing plant is operating in the Ivory Coast, and one is operating in Guinea. A third was built in Benin in 1978 but has never operated because of technical problems with the equipment.

Typically these plants process lemons for both juice and lemon oil, and process other special citrus fruits such as bergamot and bigarade exclusively for oil. Other citrus fruit such as oranges, grapefruit, and mandarins may also be processed for juice, but only as secondary products.

Equipment developed in Italy for lemons extracts oil from the skin by a rasping action in rotary drums, the oil being carried away by a water wash and separated in a centrifuge. The fruit is automatically cut in half and fed to juice extractors. Bergamot and bigarade fruit go through the oil extraction phase only, the bitter fruit being discarded.



Lemon juice is concentrated and shipped in drums to Europe where it is used in fruit drink manufacture. The oil is used for flavoring in the European confectionery and cosmetic industries and for the manufacture of alcoholic drinks (apéritifs). The essential oil industry has been increasingly affected by low-cost artificial flavors, so that only higher value products now use the true flavors.

The industry suffered from a decline in demand during the 1974-78 period, but is now returning to health. In the Ivory Coast, thanks to government intervention, abandoned orchards are being replanted and the processing plant has been reequipped. The growers' cooperative, with 125 active members, is also a member (together with Ivorian and foreign private investors) of the consortium which operates the processing plant. At this time, the plant is operating at less than 50 percent of capacity, but production is steadily increasing.

Little could be learned about the present status of the Guinean firm SIPAR. The operation has been in existence since at least the 1950s, originally as a French-owned private venture. It is now operated as either a state or joint state/ private venture. It is known to produce essential oils, including oil of lemon, bigarade, and bergamot.

Due to market uncertainties, no further ventures of this kind should be undertaken without a thorough market analysis. This analysis should include projections of future supply and demand worldwide, as well as of the West African market for citrus flavor concentrates used in carbonated beverages. Participation in such a venture by foreign buyers of the final product would be highly desirable to guarantee market outlets on a long-term basis.

Diverse Fruit Juice Processing

There are six diverse fruit juice processing plants in the seven countries surveyed: three in Nigeria; one in Sierra Leone, which is not operating; and two in Guinea, of which one is not operating. Most of these types of plants process citrus juices and some mango juice as well. We have no first-hand information on these plants, but we understand that they rely for the most part on imported juice, supplies of which are subject to interruption for economic reasons.

The plant in Sierra Leone is shut down because of problems with raw material supplies, mainly due to the admixture of bitter varieties of oranges in fruit delivered to the plant for processing. It was not possible to get any information about the plants in Guinea. (In addition to these plants, there are reportedly one fruit juice plant in Mali and one in Niger.)

Some enterprises of this type have relied on the collection of fruit from farmers in the area of the plant, the farmers usually being organized into some kind of cooperative. This loose type of association has not worked well in most cases in West Africa. An organized system of production and delivery, inspection and quality control, backed up by extension services and credit, seems to be required for success. This can best be assured by some kind of central management of both production and processing operations. Another alternative is a company-owned plantation supplying one-half to two-thirds of needed supplies, plus some kind of contractual arrangements for the remainder. Several tomato paste manufacturers also produce mango juice, as mangoes can be obtained in the same area and are available after the tomato season.

The potential feasibility of fruit juice processing is discussed in Section D. Initially the fruit juice processing project would rely mainly on the export of concentrated juices to Europe and the Middle East. Domestic West African markets for packaged juices are still too small to support such a plant serving only one or two countries. Economic integration, together with expanding urban markets for juices, will change this situation within the next few years. Market size and demand are discussed in Section C.

#### Multiproduct Plant

The SALGUIDIA plant in Guinea may be referred to as multiproduct, as it will produce pineapple slices and juice, mango juice, and citrus juice and oils. This product range should permit the plant to operate 10 months of the year. Pineapples are to be processed from January through July; citrus fruits, from January to March; and mangoes, from March through July. After this 7-month processing season, reprocessing (packaging) of juice stored in drums in cold storage will probably take place. The remaining 2 months will be taken up by repairs to and maintenance of the plant.

An extended operating season such as this permits better utilization of the company's fixed investment in plant and machinery, reducing unit production costs. It also minimizes seasonal variations in employment.

A description of this plant appears in Appendix A (Profile No. 6).

### Planned Processing Projects

During the course of the study, information was collected on fruit and vegetable processing projects which have been or are under study. Also included are four projects (in Mali, Mauritania, Niger, and Togo) which were considered at the Dakar Industrial Forum held in November 1982. Sixteen such projects are listed in Exhibit I-5. This list is not exhaustive, even for the seven countries visited, nor are these projects necessarily going to be implemented. The list is included because it indicates the direction new development could take.

With the exception of two projects -- those involving banana and plantain flour -- all these projects are of types that are already operating, namely tomato and fruit juice projects. It would appear from an examination of this list that investors and promoters of projects continue to be interested in such industries.

### Research Activities

The research projects listed in Exhibit I-6 again represent only those projects about which we heard during our visit, and the list is not exhaustive. Although we are aware of a number of other projects, they appeared to be only in the conceptual stage and not projects on which work had actually been done.

Of the four projects listed in Exhibit I-6, three have to do with drying or dehydrating vegetables to reduce spoilage and extend storage time or shelf life.

Exhibit I-5. Fruit and Vegetable Processing  
Projects Under Study

Country/location	Type of project	Remarks
1. Nigeria - Gongola State	Tomato paste production with associated farm	Joint venture involving Nigerian Government and European food processing company
2. Nigeria - Kaduna	Tomato paste and other products	Joint venture with Hungarian cooperative or state organization
3. Nigeria - probably Ibadan	Plantain flour	Project of National Horticultural Research Institute to erect pilot plant
4. Nigeria - Plateau State	Tomato paste production and associated farm	Project proposed by a U.S. company; delayed pending completion of negotiations with Nigerian Government
5. Sénégal - Ziguinchor	Diverse fruit juices and jams	Processing would begin with imported juice concentrates until trees mature
6. Ivory Coast - Séguéla	Orange juice	Probably one or the other project will be implemented, but not both
7. Ivory Coast - Daloa-Séguéla area	Lime and other citrus juices and oils (plus exports of fresh limes)	
8. Ivory Coast - Bimbresso	Utilization of bananas rejected from fresh exports to make banana flour (to be mixed with manioc flour for baby food)	--

I-30.

(Continued)

Exhibit I-5 (Continued).

Country/location	Type of project	Remarks
9. Ivory Coast - Bouna	Tomato paste (3,000 tons/yr)	To be implemented after Sinématiali plant reaches capacity
10. Ivory Coast - Boundiali	Tomato paste (3,000 tons/yr)	To be implemented after Sinématiali plant reaches capacity
11. Guinea - Mamou	Juices and canned fruits and jams from tomato, mango, and citrus fruits	Renovation of existing plant; feasibility study needed
12. Guinea - Linsan	Concentrated fruit juices, canned vegetables; with associated farm	Feasibility studied by Italian firm
13. Mali	Orange juice concentrate (130 tons/yr) and essential oils	Financing being sought
14. Mauritania - Rosso	Tomato paste (1,700 tons/yr)	Financing being sought
15. Niger	Tropical fruit processing and tomato paste manufacture (expansion)	Financing being sought
16. Togo	Tomato paste concentrate (2,900 tons/yr)	Financing being sought

## Exhibit I-6. Research Projects

Country	Research organization	Subject
Nigeria	National Institute of Horticultural Research, Ibadan	Dehydrated okra for soups
Senegal	Institut de Technologie Alimentaire (ITA) USAID and SOMIVAC	Simple solar dryers for fruit and vegetables
Ivory Coast	Ivoirienne de Technologie Tropicale (I2T)	Industrial processing of manioc into flour and precooked products (gari, attiéké)
Sierre Leone	ACRE project	Drying and storage of onions in special sheds developed in Sénégal

Dehydration of okra would be done on an industrial scale, with the dehydrated okra packaged in paper envelopes for soup making. It is likely to produce a relatively high-cost product which would be bought mainly by urban consumers.

Onion drying and storage are, strictly speaking, not processing activities. However, given the currently high levels of onion imports and the storage losses being experienced with locally grown onions, they are matters for priority attention.

Solar dryers, constructed almost entirely from local materials by villagers, offer a promising low-cost way to cut losses from spoilage in the glut season of tomatoes, pimento, sweet peppers, okra, and numerous other vegetables, as well as bananas and mangoes.

Further work needs to be done on the acceptability of the dried product by consumers.

The whole area of "composite flour," defined here as a mixture (from 10 to 50 percent) of locally available flour with imported wheat flour, offers enormous potential for reduction of imports. Relevant research is being conducted in the Ivory Coast and Nigeria. This subject is discussed in further detail in Section C.

#### Summary

Existing fruit and vegetable processing plants in West Africa consist mostly of (1) tomato paste plants, in some cases also producing mango juice, (2) pineapple processing plants producing canned slices and juice, (3) fruit juice plants, primarily processing citrus fruit, and (4) plants producing citrus oils and concentrated citrus juices.

Tomato paste processing plants are producing for local sale (import substitution) and are high-cost operations compared to imported paste. Their success is strongly influenced by the degree of protection they enjoy from imports. Much of the high cost derives from the fact that processing plants -- located in interior areas remote from the coast -- are importing either cans or tins for making their own cans. Four plants are now operating. Those which do not directly control their source of tomatoes are experiencing difficulty in getting enough supplies to operate at profitable levels.

Pineapple processing plants produce primarily for export to Europe (and to a lesser degree to West African countries). They are being badly hurt by lower cost product



from Asia in the European markets. The reason for this cost disadvantage relative to Asian products has to do with the higher shipping costs from Africa, higher labor costs, and higher costs for such supplies as sugar and containers.

Concentrated citrus juices and citrus oil plants, exporting to Europe, are relatively successful at present after several years of poor markets. The market for special citrus oils, such as bergamot and bigarade oil, upon which these plants depend does not appear to offer as favorable growth prospects as that for juice products.

Fruit juice plants, those producing concentrated or single-strength juices for local sale, including citrus, mango, and other products such as jams, have mixed success. Because of the lack of organized local production, many depend on supplies of imported juice which are subject to interruption due to economic conditions.

## C. MARKETS FOR PROCESSED FRUITS AND VEGETABLES

### Introduction

This section evaluates the markets for processed fruits and vegetables which are or could be available to processing industries in the ECOWAS region. These include both (1) markets within ECOWAS, i.e., sales in the country of plant location, plus those to other member countries of ECOWAS, and (2) exports, primarily to Europe and the Middle East.<sup>1</sup> Wherever possible, we have compared estimated market size with current supply.

Because time did not permit us to prepare a full market analysis, this discussion is necessarily more qualitative than quantitative. However, by consulting other available studies and knowledgeable persons in the industry, it was possible for us to estimate current demand for some products.

Demand, as opposed to current consumption, is the amount that would be consumed in the absence of restrictions on availability. (Consumption is composed of local production plus imports, minus any exports.) In countries where restrictions on imports exist, we have attempted to take the restrictions into account in estimating demand.

Trade in processed fruit and vegetables in West Africa consists almost entirely of imports from Europe; there is little inter-African trade. One large-volume import item is tomato paste. This product appears on the import list of

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1. Other African markets are not considered in this study. These markets, such as Central Africa, represent a rather limited potential for additional sales.

every country. Even where there is local production, it meets less than half of demand. Another major import is fruit juice in the form of concentrates, syrups, or beverages, despite the fact that considerable potential exists for expansion of production in Africa, for export as well as local consumption. Wheat and wheat flour have been and are the largest volume food item imported into the region. Efforts are being made to find substitutes for at least a portion of wheat flour by mixing it with locally available products made from cassava, plantains, and other materials.

This section, then, examines the demand for the following three product categories:

- . Tomato paste;
- . Citrus fruit juices and citrus oils, and tropical fruit juices; and
- . Composite flour.

#### Markets for Tomato Paste

Demand for tomato paste in West Africa far exceeds local production; large amounts are imported every year. Thus we are concerned in this discussion exclusively with domestic West African demand. Exports would, in any case, be out of the question, as European tomato paste can be produced for one-quarter to one-third the cost of the African product.

#### Guinea, Sierra Leone, Liberia

The Mano River Union reports that current (1981) imports of tomato paste by its three member countries total 6,185 tons. Projecting this forward to 1983 at a 7 percent annual

rate of growth (a figure used in several recent market studies), consumption would be about 7,000 tons. As there was no local production in 1981, this amount represents a per capita consumption of 0.63 kg annually for the 11.4 million inhabitants. There were, however, restrictions on imports in both Guinea and Sierra Leone during recent years.

#### Ivory Coast

In the Ivory Coast, current demand is estimated by SODEFEL at 10,000 tons, against current production of only about 1,400 tons. The balance is imported. With a population of 7.9 million, this represents consumption of 1.68 kg/year per person.

#### Nigeria

The sole processor of tomato paste in Nigeria estimates 1982 consumption at 14,000 tons (say 15,000 tons in 1983), against production of 4,500 tons. The balance is made up of official and unofficial imports. Large tonnages of paste are smuggled into the country at prices well below locally produced paste, and also below officially imported paste, which is subject to 100 percent duty. The 15,000 ton figure gives a per capita consumption of only 0.20 kg., which appears too low.

#### Sénégal

Demand for tomato paste in 1980 was estimated by local processors at 8,000 tons per year. Projecting this to 1983 at a 7 percent growth rate gives a demand of about 10,000 tons. Few import restrictions exist in Sénégal. The two existing plants are producing an estimated 1,500 tons annually.

Benin

The state agency charged with fruit and vegetable processing in Benin estimates demand for tomato paste at 1,400 tons annually. The existing production unit is not yet in operation.

Summary

The foregoing data may be summarized as follows:

	Estimated demand (tons)	Per capita demand (kg)	Current prod'n (tons)	Prod'n as % of demand
Ivory Coast	10,000	1.68	1,400	14
Nigeria	15,000	0.20	4,500	30
Sénégal	10,000	1.85	1,500	15
Benin	1,400	0.38	0	0
Guinea, Sierra Leone, Liberia	7,000	0.63	0	0
	<u>43,400</u>		<u>7,400</u>	<u>17</u>

If operated at capacity, the four tomato paste plants now operating in the Ivory Coast, Nigeria, and Sénégal (2 plants), plus the one scheduled to begin operation next year in Benin, would produce roughly 16,400 tons of paste per year. Moreover, a number of tomato paste projects are being planned in the Ivory Coast, Nigeria, Mauritania, Niger, and Togo which, if implemented, would add another 30,000 tons to the supply. As the above tabulation indicates, however, local production from the operating plants is now meeting only about 17 percent of demand.

It is reasonable to expect that demand for what is essentially still a new product in Africa will increase as more people develop a taste for it, so we can expect to see

low per capita consumption in areas where little tomato paste has been available in the past. Nonetheless, our judgment is that the 15,000 ton estimate for Nigeria is based mainly on current consumption rather than demand, and that real demand may be twice as much. We suspect that the real demand in Guinea, Sierra Leone, and Liberia may also be higher than that shown.

The seven countries have a combined population of about 109 million.<sup>1</sup> Using a conservative figure of 0.4 kg per capita (equal to the figure for Benin), demand would be 44,000 tons. For the whole of the ECOWAS region, with a population of 147 million, demand would be 59,000 tons. If existing plants operated at capacity (16,400 tons), an additional 43,000 tons would still be required to fulfill that demand. This is equivalent to about 10 plants of 4,000-ton capacity.

As stated previously, only four plants are now operating that we are aware of, and one, in Benin, is about to start operation. Another four have been shut down for some time and may or may not be operational (three in Ghana and one in Nigeria). It is not lack of demand which shut these plants down. Difficulties in organizing production, shortages of foreign exchange to buy such imported inputs as cans, and competition from less costly imports are principal reasons for the problems.

#### Markets for Fruit Juice

We have previously noted the wide variety of fruit which is potentially available in West Africa for processing.

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1. International Monetary Fund, IMF Yearbook, Washington, D.C. 1982.

We say "potentially" because, with few exceptions, these crops are not now grown on a commercial scale, i.e., in quantities sufficient to supply processing plants. We also pointed out in Section A that current production is not necessarily a factor in deciding what types of products can be produced in Africa, because new plantations closely linked to processing plants will in any case need to be established. Crops discussed below are those which can be grown in West Africa provided appropriate measures are taken to organize production.

These fruits include oranges, lemons, limes, mangoes, passion fruit, pineapple, papaya, and guava. Special varieties of citrus are grown for the production of essential oils, a product which is only of peripheral interest to us at present. Pineapple processing is well developed in several ECOWAS countries, but present market prospects are not favorable. Bananas and plantains are also widely grown but are not presently processed, although proposals have been made to produce flour from them. This subject is considered in a subsequent subsection.

Only juices and essential oils made from the above-listed fruits are considered in this study. The market for preserved (mainly canned) fruits of these kinds -- other than pineapple -- is very small. The market for essential oils from citrus is considered only in connection with flavor concentrates for beverages made in Africa. There is an export market, but our information suggests that it is not a rapidly growing one.

Both domestic West African and export markets exist for fruit juices in a variety of forms. Exhibit I-7 lists these fruits, the form in which they are produced, and the variety of final products in demand.

Exhibit I-7. Fruit Juice Markets

Product	Primary processed product	Primary market		Secondary market	
		Area	Final product	Area	Final product
Orange juice	SS juice <sup>a</sup>	Africa	Packaged fruit juice, syrup	-	-
	Concentrated juice	Africa	Flavor concentrate (for carbonated beverages)	-	-
	Oil	Africa	Flavor concentrate	-	-
Lemon juice	SS juice	Africa	Syrups	-	-
	Concentrated juice	E, ME	Flavorings, beverages	Africa	Flavor concentrate
	Oil	E, ME	Flavorings, beverages	Africa	Flavor concentrate
Lime juice	SS juice	Africa	Syrups	Europe	Flavorings
	Concentrated juice	E, ME	Flavorings, beverages	Africa	Bottlers' syrup
	Oil	E, ME	Flavorings, beverages	Africa	Bottlers' syrup
Mango juice	SS juice	ME	Fruit juices, sherbets	Europe	Yogurt, juice
	Nectar	Africa	Packaged fruit juice	-	-
	Concentrated juice	ME, E	Fruit juices, sherbets	-	-
Passion fruit juice	SS juice	Africa	Beverages (blends)	Europe	Beverages (blend)
	Concentrated juice	E, ME	Beverages (blends)	-	-
Pineapple juice	Juice	E, ME	Packaged fruit juice	Africa	Packaged fruit juice
	Concentrated juice	E, ME	Diluted for fruit juices	-	-
Papaya juice	Juice	ME	Packaged fruit juice (blends)	-	-
	Nectar	Africa	Packaged fruit juice (blends)	-	-
Guava juice	Juice	ME	Fruit juice (blends)	-	-
	Nectar	Africa	Packaged fruit juice (blends)	-	-

E = Europe.

ME = Middle East.

a. Single-strength (full-strength) juice.



Markets to be examined below include West African markets for citrus flavor concentrates and fruit juice, and European and Middle East markets for juices and nectars. Much of the discussion is qualitative rather than quantitative, since time did not allow a study of export markets or even an in-depth study of African markets.

West African Market for Citrus  
Flavor Concentrates

A potentially large market for citrus juices in West Africa is the carbonated beverage industry. Citrus-based soft drinks in the United States are typically made from flavor concentrates which contain citrus oils (extracted from the peel of the fruit) and concentrated citrus juices. However, artificial flavors may be substituted for both. Information obtained from the Coca-Cola Company indicates that flavor concentrates used in their 34 bottling plants in West Africa (the ECOWAS region plus Gabon, Cameroon, and the Central African Republic) are imported from Europe and contain no citrus juice (although citrus oil is used). Clearly this situation offers an opportunity to establish processing industries in West Africa producing citrus flavor concentrates, taking advantage of natural growing conditions for citrus trees. Further study would be required to determine the cost of producing these concentrates. Certainly they would be higher in cost than artificial flavors. ECOWAS member states could, however, establish a policy favoring locally produced flavor concentrates by imposing restrictions on imported products.

The Coca-Cola Company estimates the total market for carbonated beverages in West Africa, plus the three countries named above, at 9 million hectoliters annually. Excluding the three non-ECOWAS countries, with a population of 2.4

percent of the total, we conclude that the ECOWAS market is roughly 8.8 million hectoliters (6 liters per capita). This is more or less consistent with data for 1971 reported in a study by SPEAF<sup>1</sup> which showed per capita consumption in various West African countries to range from 0.71 liters to 7.48 liters. Of total consumption, about 60 percent is of citrus-based beverages. Assuming this percentage breaks down into 35 percent for orange and 25 percent for lemon and lime, demand would thus be: orange beverages, 3 million hectoliters; and lemon and lime beverages, 2 million hectoliters. Utilizing formulas typical for the United States, these figures translate into the following demand for flavor concentrate ingredients:

- . 60° Brix orange juice - 267,000 liters  
(Equivalent in 45° Brix - 355,000 liters);  
and
- . Cold pressed orange oil - 126 tons.

Less information is available on lemon-lime flavor concentrates. They require lemon and lime oils and may use lemon juice. If we assume the same concentration of oils, we have a demand for about 84 tons of lemon and lime oil. Concentrated lemon juice we may assume to be used at half the concentration of orange juice, or 89,000 liters.

#### West African Market for Fruit Juices

In contrast to that for bottled carbonated beverages, the market for preserved juices is quite undeveloped. Current consumption, almost totally of imported supplies, is

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1. SPEAF, Etude de Factibilité: Transformation Industrielle des Productions Fruitières de Yamoussoukro, Brussels, Nov. 1975.

too low and fragmented to serve as anything other than an indication of market demand. When the cost of imported juice is compared with that of the fresh fruit (especially oranges) available virtually year-round in Africa, fruit juice in cans, bottles, or cartons must be considered a luxury item. Consumption is therefore heavily concentrated in urban areas.

Some data on current consumption are available from feasibility studies done in Sénégal and the Ivory Coast. In 1971, per capita consumption of fruit juice of all kinds in selected West African countries was estimated as follows:<sup>1</sup>

<u>Country</u>	<u>Per capita consumption (gm)</u>
Ivory Coast	87
Upper Volta	8
Mali	20
Mauritania	108
Niger	23
Sénégal	119

In the same year, only the Ivory Coast was a producer of fruit juice (pineapple juice). In the remaining countries, all juice was imported.

The study found a fairly good correlation between per capita GDP and fruit juice consumption, and on this basis extended consumption forecasts to 1980 and 1985 for most West African countries. Per capita consumption figures for 1980 were as follows:

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1. SPEAF, op. cit.

<u>Country</u>	<u>Per capita consumption (gm)</u>
Ivory Coast	125
Upper Volta	12
Mali	20
Mauritania	126
Niger	27
Sénégal	142
Benin	43
Togo	77
Gambia	77
Sierra Leone	86
Liberia	211
Ghana	138
Nigeria	67

For these 13 ECOWAS countries (excluding Guinea, Guinea Bissau, and Cape Verde), consumption of 10,740 tons was projected for 1980. This is equivalent to a per capita consumption of 76 gm for these countries. Adding the missing three countries at a conservative 30 gm per capita gives total consumption of 11,000 tons. It is interesting to note that 85 percent of estimated consumption is represented by four countries: Nigeria, Ghana, the Ivory Coast, and Sénégal.

Another study<sup>1</sup> projected 1980 consumption of juice in Sénégal (based on past imports) as follows:

<u>Juices</u>	<u>Consumption (tons)</u>
Non-sweetened	
Pineapple (from Ivory Coast)	637
Orange	197
Lemon, grapefruit	24
Tomato	7
Sweetened (syrops)	<u>149</u>
Total	1,014

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1. SONEDI, Etude de Marché pour l'Installation d'une Usine de Fruits à Ziguinchor, Dakar, Sept. 1978.

This works out to 180 gm per capita, which may be compared to the forecast for Sénégal in the SPEAF study of 142 gm. On this basis, the SPEAF estimates appear conservative.

A study done for the Mano River Union (Sierra Leone, Liberia, Guinea) estimated the effective 1981 per capita demand for member countries as follows:<sup>1</sup>

	<u>Demand (gm)</u>
Sierra Leone	89
Liberia	267
Guinea	23

The figures for Sierra Leone and Liberia accord very well with those in the SPEAF study.

It is difficult to translate consumption into demand due to the restrictions imposed on imports of luxury products such as fruit juice by some ECOWAS countries in recent years. We can assume that 1971 consumption data, utilized in the SPEAF study, were approximately equivalent to demand at that time since few import restrictions were then in force. The 1980 consumption forecasts in the study are more in the nature of demand than consumption forecasts, since they are based on income and population projections. Lacking more recent market data, we conclude then that the foregoing figure of 11,000 tons can be taken to represent 1980 ECOWAS demand for fruit juice.

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1. Mano River Union, Industrial Project Development Unit, Market Survey and Promotion for Mabole Fruit Company, Free-town, Oct. 1981.

The rates of growth in the demand for fruit juice in West Africa as estimated by various studies ranges from 5 to 8 percent. Adopting a conservative growth rate of 6 percent, 1983 demand would be 13,000 tons.

The composition of this demand is also difficult to estimate. Availability is certainly a factor: for instance, the consumption of pineapple juice is high where it is available, mainly in the Ivory Coast, but also in neighboring countries where the juice is exported, such as Sénégal. Elsewhere orange juice predominates, as it does in Europe and the United States. (It accounts for roughly 70 percent of all juice consumed in Europe.)

Imports in 1979 into the Mano River Union, which were relatively unrestricted, consisted of the following types of juices:

<u>Type of juice</u>	<u>Percent of total juice imports</u>
Orange	16.0
Grapefruit	1.4
Other citrus	5.5
Pineapple	4.5
Tomato	4.8
Other fruit and vegetable juices	32.9
Mixtures	34.9

Although orange juice again predominates, there is certainly evidence of demand for a wide variety of juices.

Current imports include such products as single-strength juice in cartons and cans and pasteurized concentrated juice in bottles (for dilution and mixing in the home). In an

Abidjan supermarket, for example, we saw syrups of orange, mandarin, lemon, and passion fruit, as well as cans and cartons of orange juice.

We were unable to obtain sufficient information on existing processing plants to estimate the current supply of processed fruit juice. West African production of fruit juices, other than pineapple juice, is very limited at present, as noted previously. A processor in Nigeria, for example, is bottling orange, lemon and lime, pineapple, and black currant juices entirely from imported single-strength juice. Total annual requirements are 665 tons, of which 600 tons are citrus juices.

There is as yet no market for frozen concentrated juices (the predominant form consumed in Europe and the United States) due to the lack of home freezers and refrigerated transport.

To summarize the foregoing, the West African market for fruit juices is as yet undeveloped. Very little juice is being produced from locally available raw materials. Current consumption, limited to the more affluent and often restricted by import controls, is of a variety of juices in different forms and packages.

#### European Demand for Fruit Juices

The following discussion is based on information contained in various reports prepared during the last 5 years which we were able to review in West Africa, and published U.N. statistics. No provision was made in the terms of reference of this study for direct investigation of European markets.

The U.N. trade statistics given in Exhibit I-8 indicate the large market for fruit juices in Europe. Over a million tons of juice imports are represented by these figures. It has been estimated that, of total European consumption, orange juice accounts for 70 percent; other citrus juice, for 10 percent; and pineapple juice, for between 5 and 10 percent. Orange juice is mostly frozen concentrate from the United States, Brazil, and other large producers. It is considered unlikely that West Africa could compete in this market.

Exhibit I-8. Fruit and Vegetable Juice Imports,  
Selected European and Middle East Countries

Country	Imports (metric tons)
<u>Europe (in 1981)</u>	
Netherlands	240,421
West Germany	367,207
Belgium-Luxembourg	73,235
Austria	37,011
Ireland	16,319
Italy	15,587
Norway	12,967
France	161,783
Greece	2,922
United Kingdom	182,262
<u>Middle East (in 1980)</u>	
Jordan	3,114
Saudi Arabia	251,951
Tunisia	79

Source: United Nations, Commodity Trade Statistics, 1981.



Tropical Fruit Juices

The available data did not allow us to estimate demand for tropical juices separately. A study prepared in Sénégal<sup>1</sup> reported on European consumption of the juice of two tropical fruits as follows (1971 data on mango products unavailable):

	<u>Consumption (tons)</u>	
	<u>1971</u>	<u>1975</u>
Mango juice	-	358
Mango nectar	-	423
Passion fruit juice	1,000	2,430

Principal importers of mango juice were the United Kingdom (273 tons) and France (75 tons). Principal importers of passion fruit juice were West Germany (1,800 tons), the Netherlands (225 tons), Switzerland (175 tons), Sweden (165 tons), and France (50 tons). Most of these imports presently come from East Africa.

Mango juice or "pulp" (often referred to in this way because of its higher solids content) is a very sweet product, and many Europeans have not developed a taste for it as a drink. It is more often used to flavor yogurt. The diluted form -- nectar -- is consumed as a drink to some extent, but is often mixed with more acid juices such as lime or passion fruit.

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1. Institut de Technologie Alimentaire, Seminar sur la Promotion en Europe des Jus d'Agrumes et des Fruit Exotiques, Dakar, 1977.

Although we have no data on Eastern Europe, consumption of mango juice there has reportedly been increasing.

While mango juice consumption is low in Europe, passion fruit juice markets appear to be expanding rapidly, judging from the 1971 and 1975 figures cited above. We have in fact seen an estimate of 1980 consumption of 10,000 tons.

### Citrus Juices and Oils

Evaluation of the European market for citrus juices and oils will require some contact with European importers and consumers. Concentrated lemon juice and lemon oil are presently being exported to Europe from the Ivory Coast (along with oil of bergamot and bigarade). Markets exist also for lime juice, concentrated lime juice, and lime oil. Manufacturers of carbonated fruit beverages are buyers of concentrated juice and oils in the form of flavor concentrates. The oils are also used in perfumes and in the confectionery industry.

Consumption in Europe (the CEE-9 plus all other West European countries) of "limonades" or fruit-based carbonated beverages is estimated at 15 million tons (150 million hectoliters). This represents a per capita consumption of 48 liters/ year. (In contrast, West African consumption was estimated above at only 6 liters/year.)

To give some idea of the size of this market, if this volume were all in orange-flavored drinks formulated the way they are in the United States, demand for concentrated orange juice (65° Brix) would be 13,350,000 liters, and for orange oil, 6,300 tons.

Middle East Demand for Fruit Juices

The Sénégal study referenced above reported that 1975 imports of mango juice in the Middle East totaled 10,000 tons. Principal importers were:

	<u>Imports (tons)</u>
Saudi Arabia	6,000
Kuwait	1,500
Bahrain	1,000
United Arab Emirates	500

The contrast with European imports of slightly less than 800 tons of mango juice and nectar in the same year is quite striking. Saudi Arabia, particularly, represents an enormous potential market for West African fruit juice processors.

An on-the-spot study of the market would be necessary to establish such factors as recent demand trends, marketing channels, present sources of supply and prices, etc.

Markets for Composite Flour

During the 1975-77 period, West African imports of wheat and wheat flour averaged 1,234,700 tons (wheat equivalent) annually.<sup>1</sup> These imports had a value of US\$245 million (although some was imported under food aid programs). In addition, 594,900 tons of rice, 138,900 tons of corn, and 199,600 tons of other grains were imported. Wheat, however, represented 57 percent of the total. By 1981, total grain

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1. Food and Agriculture Organization, FAO Trade Yearbook, 1977.

imports had reached 2,036,000 tons, worth US\$389 million.<sup>1</sup> Virtually all imported wheat goes into the making of bread.

Research has been done in West Africa and in other tropical areas on composite flours -- mixtures of wheat flour and of flour or starch from locally available crops. The work is extremely significant for the ECOWAS region, as it could lead to important savings in foreign exchange and much greater self-sufficiency. Among the crops studied have been cassava and plantains.

#### Substitutability of Other Products for Wheat in Bread

##### Cassava, Price, Yams, Corn

Results of research in the United States on the use of nonwheat flours in bread has been documented in a recent report.<sup>2</sup> Mixtures of wheat flour with cassava flour, rice flour, or yam flour were used to make bread, and the results were measured. The admixture of other flours with wheat altered the properties of the dough, mainly by weakening the dough structure, which produced an unsatisfactory bread. It was found that this problem could be largely overcome by the addition of 0.5 percent sodium stearoyl-2 lactylate. (This substance, SSL, has been approved in many countries as a baking additive.) Mixtures with 20 percent cassava, yam, and rice flour produced acceptable grain and loaf volume, although the volume was somewhat below that of wheat bread.

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1. Food and Agriculture Organization, FAO Trade Yearbook, 1982.

2. Cho C. Tsen (Kansas State University), "Using Non-Wheat Flours and Starches from Tropical Crops as Bread Supplements," in Tropical Foods, vol. 1.

Additional tests were run with mixtures containing 10, 20, and 30 percent cassava flour and 0.5 percent SSL. Volume and grain characteristics were considered adequate at admixtures of up to 20 percent cassava flour. The same is true of rice, corn, and yams.

From a nutritional standpoint, the addition of any of the tested flours lowers the protein content of the flour. The addition of 20 percent cassava flour, for example, lowers protein content by about 18 percent. However, it was found that bread made with 4.7 percent soy flour and 15.3 percent cassava flour gave a protein level approximately equal to that of wheat bread.

Breads made from composite flours of the types discussed above were submitted to a taste panel of persons from developing countries, and all the breads were judged acceptable.

#### Plantain Flour

At the National Horticultural Research Institute at Ibadan, Nigeria, research has been conducted on the substitution of plantain flour for wheat in baking. The work, sponsored by the Federal Government of Nigeria jointly with the FAO and the UNDP, showed that acceptable results were obtained with plantain flour content as high as 50 percent. The government has plans to build a plant to produce plantain flour and to interest the private sector in building others under license.

#### Millet and Sorghum Flour

A recent conference in Dakar, held under the auspices of the Institut de Technologie Alimentaire, discussed the

substitution of locally available grains in the Sahelian countries, such as millet and sorghum, for wheat in baking.

#### Igname (Yam) and Plantain Flakes

Specialists at the Ivoirienne de Technologie Tropicale in Abidjan state that flakes made from dried plantain and igname (yam) would have a market as an additive to breakfast cereals.

#### Banana Flour

Banana-producing countries such as the Ivory Coast have for some years tried to find uses for bananas rejected by packing houses. One study has proposed the manufacture of a precooked dry baby food made of banana flour and manioc flour.<sup>1</sup>

#### Size of Market

Substitution of 20 percent of wheat imports by local products in baking would create a demand for 247,000 tons of these products annually, and replace imports valued at US\$49 million on the basis of 1975-77 data. We estimate this figure at US\$78 million in 1981, based on import data for that year. This would create a requirement for a large number of plants in West Africa to process cassava, plantains, or other products, depending on location.

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1. ITIPAT, Projet d'Utilisation des Escarts de Triage de la Banane, April 1968.

Summary

West African markets exist for processed tomato paste and fruit juice products. Tomato paste is especially important as it has in recent years become a widely consumed item. Current demand for the ECOWAS region is estimated at 59,000 tons. The four plants now operating are producing only 7,400 tons of paste annually, but could produce 15,000 tons if operated at capacity. Another 1,400 tons will be produced in Benin once a plant already built there goes into operation. The status of a reported four additional nonoperating plants in Nigeria and Ghana is unknown. Without taking these into account, additional capacity of 43,000 tons is required to satisfy West African demand. This is equivalent to roughly 10 plants of 4,000-ton capacity, similar to those now operating. Currently planned projects in a number of countries would add 30,000 tons of additional paste if implemented.

In contrast to demand for tomato paste, West Africa's demand for fruit juice is relatively weak but growing. The market is twofold: that for products used in making flavor concentrates for carbonated beverages, and that for pure fruit juices. Virtually all flavor concentrates used by soft drink bottlers in West Africa are now imported. Based on current consumption data, we estimate an annual demand for 267,000 liters of 60° Brix concentrated orange juice, 126 tons of orange oil for orange drinks, and 89,000 liters of concentrated lemon juice plus 84 tons of lemon and lime oil for lemon-lime drinks.

Fruit juice demand is estimated (based mainly on import data) at 13,000 tons annually for ECOWAS. It consists mainly of citrus juices (predominantly orange) and lesser

amounts of pineapple and temperate-climate juices such as apple and black currant juice. Demand is low due to the almost year-round availability of fresh fruit such as oranges and the high price of imported juices (bought almost exclusively by urban dwellers).

The European market offers good prospects for the sale of juices from such tropical fruits as passion fruit. There is a sizable demand in Middle Eastern countries for all kinds of tropical fruit juices, especially mango.



## D. FEASIBILITY OF REGIONAL PROCESSING INDUSTRIES

Introduction

In this section, we present our findings as to the feasibility of fruit and vegetable processing industries in ECOWAS member states. However, because some confusion may attach to our use of the term "feasibility," we will first briefly describe three types or levels of feasibility-related assessments that are commonly carried out by consultants, in order to clarify the scope of this current study and its relationship to the other study types.

Briefly, then, the scope and purpose of the three types of studies are as follows:

- . Project identification -- This type of study identifies potentially feasible projects, after reviewing a given sector of a country's economy and noting the availability of raw materials and market demand. It is basically a planning document. Projects are described in general terms, including type of process and product, raw material requirements, plant size, output, markets, and order-of-magnitude investment costs, when possible.
- . Preliminary feasibility (or prefeasibility) study -- This type of study is related to a specific processing venture and usually, but not necessarily, to a specific location. It is generally used to attract investor interest in a project. Although it is more narrowly defined than a project identification study, equipment specifications are general and investment and operating costs are estimated only within broad categories. Markets are defined and sales are forecast without being specific as to customer and product specifications. Financial projections are sufficiently detailed to indicate approximate fixed and working capital requirements, sales revenue, operating cost, and profit and loss.

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- . Full-scale feasibility study -- This type of study is often performed on behalf of or by potential investors in a project, and may be used to raise capital. It is considerably more costly than a prefeasibility study. It is specific as to location and markets. Equipment is specified in detail, with costs based on recent quotations, including shipping and installation costs. It may include preliminary engineering design if the process is new. All auxiliary equipment and buildings are specified and costed. Operating costs are detailed, including labor, raw material, supplies, and utilities. Raw material specifications are called out. Final product specifications are stated and related to the requirements of specific markets. Financial projections are developed for 5 or 10 years in the future, including balance sheet, cash flow, and profit and loss. Investment and working capital needs are worked out, and the source of funds specified.

Given the time available in the field (2 months) and the area covered (seven countries), our work was necessarily in the nature of a project identification mission. Our aim, then, in this section of the report is to identify potentially feasible fruit and vegetable processing projects, especially those which involve regional cooperation, and to suggest the additional analysis that will be required to establish the feasibility of such ventures in specific locations.

Feasibility must be related to specific locations, not only because of technical factors (e.g., suitable climate), but also because of the great diversity among West African countries, which include:

- . Countries with nonconvertible currencies and few exchange controls, and those where currency is freely convertible and there is relatively little control over foreign exchange transactions;

- . Countries where illegal entry of imports is common, and those where it is relatively uncommon;
- . Countries with large domestic markets, and those with very small domestic markets; and
- . Countries with good internal communications (road, rail, telephone), and those where they are limited or unreliable.

Until full economic integration is achieved in West Africa, these differences among nations must be taken into account in determining the feasibility of any potential project. The political diversity of West Africa is also a factor to be considered, especially as it relates to the scope of private investment. In general, countries with socialist or state-centered economies have demonstrated a preference for state-owned and cooperative enterprises, while free-market economies have welcomed private investors. However, we note that budget limitations caused by poor economic conditions are now leading even the more socialist-style governments to give greater scope to private investment.

Currently in West Africa, almost all fruit and vegetable processing plants enjoy some degree of protection against lower priced imports. Such protection will remain necessary to ensure the viability of any project proposed in this study, at least initially, and we have therefore assumed a continuation of these policies.

It will be obvious that we are considering in this section the financial feasibility of individual ventures, rather than their economic merit. Although these ventures can benefit an individual country's or the region's economy through value added and through foreign exchange savings

(from import substitution) or earnings (from imports), we have not attempted an analysis in terms of overall economic costs and benefits to individual ECOWAS member countries or to ECOWAS as a whole.

Finally, a word should be said about the notion of regional industries as opposed to national industries. The thrust of the study is toward ventures that are regional in the sense of (1) serving market areas that include more than one ECOWAS country, (2) collecting raw or semiprocessed materials from more than one country for further processing in a single country, or (3) attracting investment to a processing venture from more than one ECOWAS country, or from international private or public sources. We have accordingly concentrated our efforts on projects which tend to encourage such intraregional cooperation.

#### Factors Influencing Feasibility

We have started from the premise that processing ventures do not necessarily have to be totally integrated. That is, it may make sense to break them down into physically separate facilities along these lines:

- . Primary processing and bulk packaging, usually located adjacent to crop production areas;
- . Reprocessing or final packaging of the product, usually located adjacent to principal markets for the product.

This approach minimizes expensive transport of containers, such as cans, from port cities to remote interior locations and back again, and allows more efficient use of expensive packaging machinery by enabling it to operate virtually

year-round on a variety of raw materials received and stored in bulk. The concept has received wide acceptance among food processors, particularly where individual markets demand different forms of consumer packaging or final treatment of the product.

With this in mind, we enumerate several factors which we took into account in commenting on the potential feasibility of processing ventures in West Africa, and which will also need to be considered in determining their feasibility:

- . Location of primary processing facilities: Primary processing facilities should be located near the source of raw materials to shorten delivery time and reduce spoilage, and to enable the processor to control deliveries. Depending on the crop, this requirement may result in plant locations remote from main coastal cities.
- . Type of primary processing and product mix: The process should conserve the product and if possible reduce its bulk. Equipment should be utilized as many months of the year as possible, which implies the processing of crops with complementary harvesting seasons.
- . Raw material supply: The supply of raw materials should be controlled by the processing unit through common or closely linked management. Where production is by farmer cooperatives, the grower-processor link should be strengthened by technical assistance and credit arrangements. The processor should ideally control directly, or through contracts, sufficient production to ensure a breakeven situation, and in any case should control no less than half of raw material requirements.
- . Bulk containers: Shipping containers used by primary processors should be suitable for bulk shipment (preferably reusable to save costs) and should conserve the product for extended periods (usually up to 6 months).

The product may have to be chilled or frozen to prevent spoilage. Shipment may be to a domestic reprocessor/packager for sale in local markets, or may be exported in the bulk container to a reprocessor/packager in a foreign country.

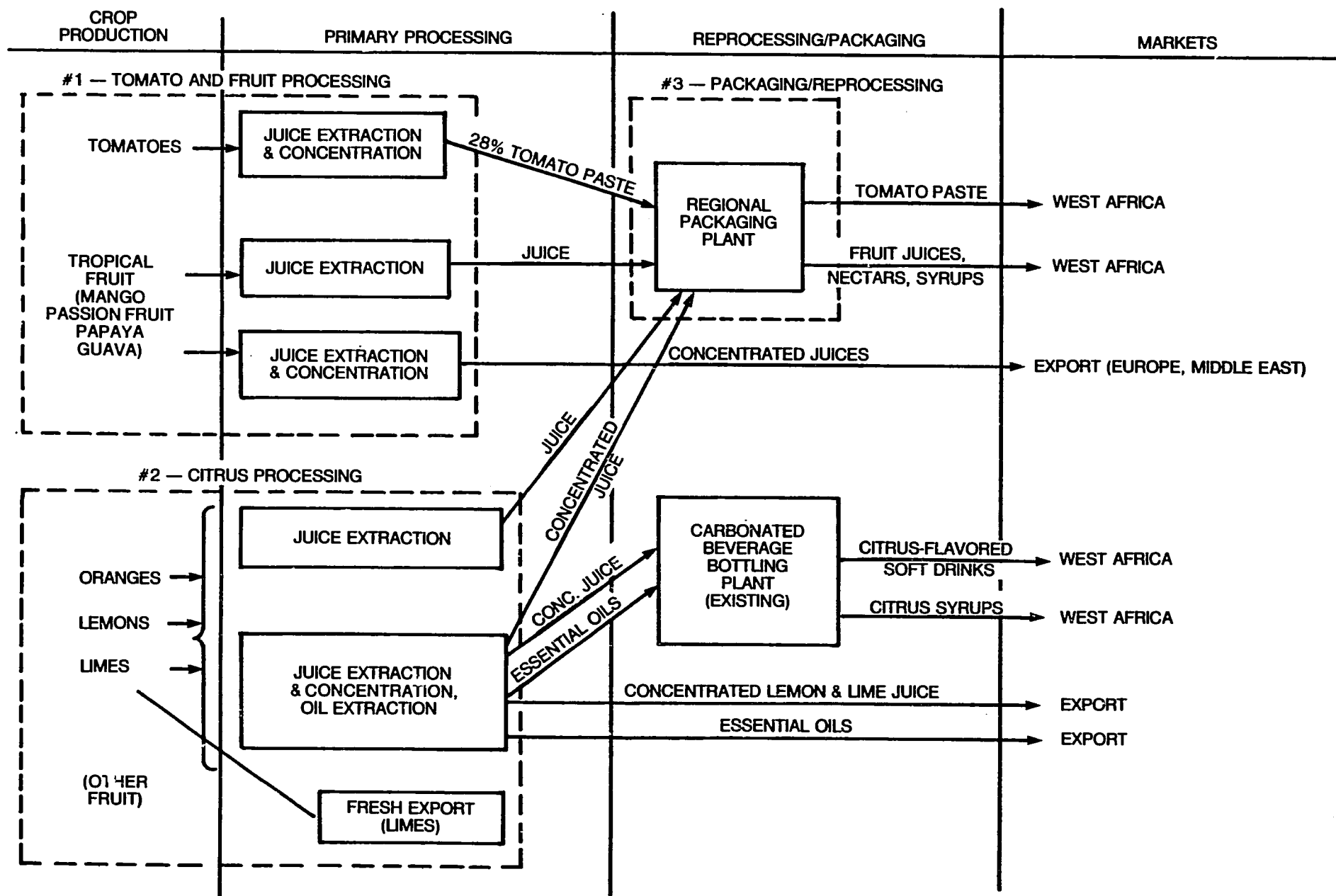
- . Location of reprocessing/packaging facility: The reprocessing/packaging facility should be located close to final consumers to reduce the cost of transporting packaging materials such as cans from the port of arrival or from container plants (where such exist). Such siting facilitates coordination with distributors who know market requirements for packaging and who may invest in the packaging enterprise. Urban locations also improve the likelihood of obtaining the necessary skilled manpower.
- . Type of reprocessing/packaging: The reprocessing/packaging facility should package the product in a minimum-cost container appropriate to the market. This might be a can, but could also be a nonmetallic container such as the Brik-Pak or Tetra-Pak (for juices) or plastic tube (for tomato paste). The facility should handle a variety of products and operate year-round to maximize the use of expensive packaging equipment. This requirement implies the need for sizable storage facilities for bulk-packaged products, including cold stores.

#### Potentially Feasible Industries

On the basis of our survey findings as to markets and raw material availability, we have proposed three separate but interrelated types of processing industries. These three types of industries, shown in Exhibit I-9, are:

- . Tomato and fruit processing plants, at inland locations suitable for tomato growing, producing tomato paste and tropical fruit juices (single-strength and concentrated) packaged in bulk for shipment to reprocessing/packaging plants;

# TOMATO AND FRUIT PROCESSING SCHEME



- . Citrus fruit processing plants located in coastal regions of West Africa where citrus fruit is grown, producing concentrated citrus juices and essential oils for West African carbonated beverage bottlers and fruit juice packagers, and for markets in Europe and the Middle East;
- . Regional reprocessing/packaging plants centrally located in West African port cities and supplied with bulk-packaged tomato paste and fruit juice from the above two industries. The plants would package these products for West African consumers on a year-round basis and also ship concentrated juice from storage to foreign customers.

The concept is basically one of primary processing plants that are located near crop production areas in widely dispersed locations in West Africa, and that ship bulk-packaged products to regional reprocessing/packaging plants located in major port cities.

Each of these three types of industries is discussed in detail in the following paragraphs.

#### Industry No. 1: Tomato and Fruit Processing

##### Introduction

Our survey of processing facilities indicated that existing tomato and fruit processing plants are self-contained units in that they do their own packaging of paste into cans, and the high cost of imported cans or tinsplate and the relatively low utilization of packaging machinery result in a high-cost product.

We propose, therefore, that further development of this industry include the creation of new "satellite" tomato and



fruit processing plants that produce only bulk-packaged paste and juice. The plants would be established at interior locations, adjacent or near to growing areas, and the product would be shipped to regional packaging plants for canning (or packaging in other types of containers).

This approach would greatly reduce the investment and operating costs of inland processing plants by eliminating the need for each plant to obtain complex and expensive packaging machinery and to ship tin cans to and from the coast. This should make it feasible to locate processing plants more widely across West Africa and to distribute income from processing more evenly among ECOWAS states.

The scheme is represented graphically in Exhibit I-10. In this example, the regional packaging plant receives supplies of bulk tomato paste and fruit juice from three processing plants, as well as citrus juice from two citrus processing plants (Industry No. 2).

#### Markets

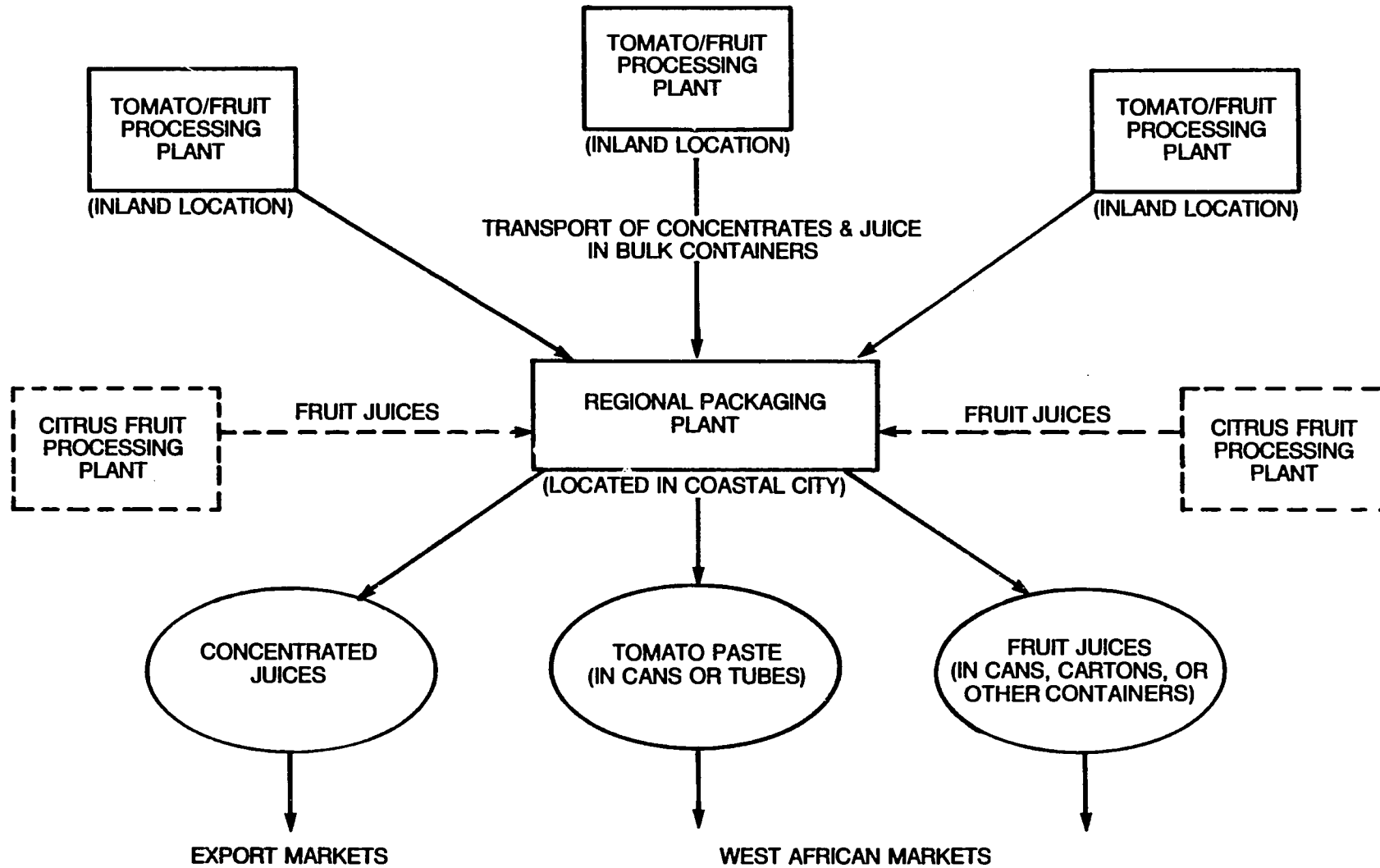
The proposed plants would be intermediate processors, i.e., they would sell their products to the final processor or packager rather than to consumers. Regional packaging plants (Industry No. 3) would be the buyers of the bulk-packaged juice and paste.

#### Location

Growing areas for tomatoes tend to be in the relatively dry inland zone, wherever water is available from rivers or wells. This was previously illustrated in Exhibit I-4, which shows the interior location of existing plants.

**EXHIBIT I-10**

**CENTRAL TOMATO PASTE/FRUIT JUICE PACKAGING CONCEPT**



Mangoes and papayas can also be grown in these areas. Further investigation is needed to determine if passion fruit and guava can be grown profitably in the drier areas or would have to be transported from more humid coastal areas. Tomatoes, as the dominant crop to be processed, dictate the inland location of these plants.

### The Process

The process is basically one of concentrating tomato and fruit juices. The key element in the system is the evaporator. It is suitable for processing of tomatoes and most fruit juices other citrus. Evaporators for citrus juices are different in that they include an aroma recovery system so that the volatile citrus oils, which contain much of the flavor, can be returned to the concentrated juice. This is not necessary for tomatoes, mangoes, or papayas; it may or may not be necessary for passion fruit, depending on the level of product quality required.

Evaporators currently in use in Africa are of Italian manufacture, and are either two-stage vacuum pans of the batch type, or two-stage continuous evaporators. Typical capacities in terms of tomato input are either 7 tons/hour or 14 tons/hour, and in terms of paste produced either 1 ton/hour or 2 tons/hour. The size recommended here would be the larger of the two.

The size of the evaporator determines plant capacity and, in turn, raw material requirements. An evaporator processing 14 tons/hour on a 24-hour basis for 75 days would require about 25,000 tons of tomatoes and turn out almost 4,000 tons of tomato paste.

In many parts of the world, mango and papaya juices, or purées, are not concentrated but are instead diluted and sweetened to make "nectars." This would be the case for juice sold on the West African market. It would be desirable, on the other hand, to concentrate juice destined for export, in order to reduce shipping costs. The proportion of fruit juice to be passed through the evaporator would depend, therefore, on market conditions.

It is assumed that 100 percent of the tomatoes would be concentrated to 28 percent tomato paste. The market for tomato juice in West Africa appears too small at this time to justify producing this product. The complete process for tomatoes consists of the following steps:

- . Receiving;
- . Washing;
- . Inspecting;
- . Chopping;
- . Heating;
- . Pulping/finishing;
- . Concentrating;
- . Drum filling.

All fruit to be processed, such as mango, papaya, passion fruit, and guava, would use a common preparation line.

The key element in the line is the "thermo-screw," a screw press incorporating heating of the product by steam injection. The complete process is as follows:

- . Receiving;
- . Washing;
- . Inspecting;
- . Heating and crushing (thermo screw);
- . Pulping/finishing;

- . Deaerating;
- . Pasteurizing;
- . Drum filling (for single-strength juice).

The line would handle 5 tons/hour of any of the above fruit. The product to be concentrated would be pumped to the evaporator following pulping/finishing. As noted above, the same evaporator used for tomatoes is suitable for fruit juices in moderate concentration (approximately twofold). Cold storage facilities would be needed to conserve the fruit juices. The need for a freezer would depend primarily on customer requirements as to product quality.

#### Raw Material Supply

The processing plant would be located adjacent to an irrigated farm producing tomatoes. Assuming yields of 25 tons/ha, which are now common in West Africa, an area of 1,000 ha would be required. At 30 tons/ha, which is very close to being achieved in the Ivory Coast, only 830 hectares would be needed. (Although a 3-year crop rotation system for processing tomatoes is commonly practiced in West Africa, with adequate phytosanitary methods this should not be necessary. Thus, the total irrigated area devoted to tomatoes could be on the order of 1,000 ha.) If sufficient water were available, it might prove desirable to raise other crops for fresh market sale, such as rice (in low-lying areas) and other vegetables, which might double the total cultivated area.

As noted above, the inclusion of tropical fruit juices allows more effective use of the evaporator by extending the processing season. Harvest seasons for tomatoes and fruit are as follows:

- . Tomatoes - January to April;
- . Mangoes - January to July;
- . Passion fruit - All year, with peak production May to October;
- . Papaya - Virtually all year; and
- . Guava - To be determined.

The actual product mix of the processing plant would be determined by market demand. Export markets for the tropical fruit juices would need to be developed, and initial requirements for these fruits might be low. However, a possible delivery schedule would be:

- . Tomatoes - January to April;
- . Mangoes - May to July;
- . Passion Fruit - May to October; and
- . Papaya - May to October.

This schedule would permit a 10-month operating season and make effective use of juice extraction and concentrating equipment.

Further study would be required to determine how best to organize the production and delivery of fruit. Although abundant supplies of mango exist, they are widely dispersed, and furthermore most are not the grafted mangoes that provide relatively high percentages of pulp. This dispersal of production is even more true of papaya. It seems clear that the processor would have to organize the production of fruit, either directly or through closely linked cooperatives.

Passion fruit is not grown at all in most countries (except for a small amount in the Ivory Coast), yet export markets are promising. Due to its rapid growth and early

maturity (full production in 18 months), as well as year-round production, it lends itself to intensive plantation cultivation. Again, this could be controlled by the processor or through cooperatives.

Another possible product to be processed is concentrated pineapple juice. This relatively new product is gaining popularity in Europe because of reduced shipping costs. It is diluted and packaged by reproprocessors. To our knowledge, Guadeloupe and Kenya are the only suppliers at present to the European market.

#### Shipping Containers

Recent developments in packaging techniques in the United States could provide West African tomato processors with an excellent low-cost, sanitary container for bulk shipment and storage of tomato paste. This is the "bag-in-box" system, which consists of a flexible plastic bag (of food-grade polyethylene and metallized film) within a rigid corrugated paperboard container.

Tomato paste is filled hot into the bag and the closure is heat-sealed; the bag within its box then moves through a cooling tunnel. The bag is virtually free of air due to the hot fill, so product degradation is minimal, and its small size (5 to 10 kg) allows for fairly rapid cooling and precludes over-cooking of the interior, as can happen in large containers. The container is light weight to reduce transport costs. (Large containers are filled with cooled product under aseptic conditions. We do not recommend aseptic processing for West Africa at this time.)

Although the bag is discarded after use, the box may be used again. The container may be used to store paste while it awaits packaging, or the paste may be sold to institutional users directly in the box.

Single-strength fruit juices may be chilled and filled into 200 liter drums, lined with polyethylene bags, for shipment to juice packaging plants. Concentrates intended for export can be similarly packaged, or put in smaller (reusable) plastic drums. Freezing is desirable to maintain maximum quality.

#### Number, Size, and Location of Plants

Our conservative estimates of demand for tomato paste in the ECOWAS region indicated a requirement for the region as a whole of 10 additional plants, each with a capacity to produce 4,000 tons of paste annually. (This does not take into account the four plants, of unknown capacity, which are shut down and may or may not be operational; if some of these were restarted, fewer than 10 new plants would be required.)

Logical sites for paste plants are Nigeria, Ghana (which has three shut-down plants), the Ivory Coast, Guinea, Mali, Mauritania, Upper Volta, and Niger. All of these countries should have suitable production areas for tomatoes, as well as mangoes, papayas, and possibly passion fruit and guava.

#### Investment Costs

The form of investment (private enterprise, state enterprise, cooperative) is a policy matter for the governments concerned. These policies vary widely among ECOWAS



member states. A typical pattern in several ECOWAS states is grower cooperatives, strongly supported at the outset by government agencies (extension services, inputs on credit). These may be established farmers who are grouped into cooperatives for the purposes of a project, or farmers who are settled onto newly established plantations where they will live and work. The most successful of these are closely linked with the management of the processing plant.

Regardless of who the investor is, however, investment in both the processing plant and in crop production facilities would be required. Processing equipment costs for a plant producing 2 tons/hour of tomato paste, and including a fruit juice preparation line, are estimated at US\$600,000. Shipping (from Italy) and installation costs would raise the total to about US\$700,000. A freezer and refrigerated storage would add another US\$100,000, for a total of US\$800,000. If power generation equipment were required, it could cost US\$150,000. The costs for a building, auxiliary equipment, and furniture could approximate US\$250,000. Total plant investment costs would thus be on the order of US\$1.2 million, including electric power generation.

The costs to develop new irrigated farmland in West Africa would include the costs of dams, canals, irrigation pumps and piping, roads, farm buildings, tractors and implements, sprayers, and possibly housing and other facilities for cooperative members. Obviously such costs could vary widely, depending on the type of system used. Figures we have seen for an 1,800 ha irrigated tomato farm in the Ivory Coast and a 450 ha fruit orchard in Nigeria both worked out to about US\$10,000/ha in current 1982 dollars. Data for other countries indicate costs ranging from a low of US\$5,000/ha for non-irrigated orchards to a high of US\$20,000/ha for irrigated farms.

These sizable investment costs have often in the past been borne, at least in part, by the state due to their "social cost" nature (i.e., infrastructure-type investments in support of farmers or farmer cooperatives). Economic strictures facing West African governments are now limiting the amount of money available for such projects. For this reason there tends to be more recourse to -- and greater scope for -- private investment in projects of this type.

#### Further Study Required

To establish the feasibility of one or more tomato and fruit processing plants of the type described above, a study should be undertaken that is designed to:

- . Expand the market study for tomato paste to the whole ECOWAS region, and assess the export market for tropical fruit juices;
- . Survey nonoperating tomato processing plants to determine the feasibility of renovation;
- . Identify locations in the ECOWAS region where new processing plants would be feasible, based on the availability of water and the suitability of soils and climate; and
- . Develop investment and operating cost estimates for processing units, and determine their financial viability based on anticipated export market prices for juice and on alternative assumptions for domestic prices of tomato paste.

The points to be covered by the study have been incorporated into the "Terms of Reference" given in Exhibit I-12 in Section E.

Industry No. 2: Citrus ProcessingIntroduction

Establishing the feasibility of a citrus processing plant in West Africa will require careful study, especially with regard to marketing aspects. Unlike the case for tomato processors, there is no single product or market for a citrus processing facility; the enterprise must rely on a number of different products if it is to be viable.

Given the numerous questions on citrus processing that require further study, we do not propose to specify the size or number of citrus processing plants to be established, nor the magnitude of the investment cost that would be required. The prefeasibility study outlined below should address these issues.

Markets

Based on our findings in the preceding section on markets, the primary products and markets for a citrus processing plant should be:

<u>Product</u>	<u>Market</u>
Concentrated orange juice	West African soft drink bottlers
Orange oil	West African soft drink bottlers
Single-strength orange juice	West African fruit juice packaging plants
Concentrated lime and lemon juice	European importers, West African soft drink bottlers
Lime and lemon oil	European importers, West African soft drink bottlers

A study prepared in the Ivory Coast<sup>1</sup> for a plant of this type took note of favorable market prospects for limes of the Tahiti variety (large fruit without seeds), and proposed that 90 percent of the limes produced be exported fresh to Europe. Rejected fruit from sorting stations would be used for processing. Fresh limes, then, represent an additional (unprocessed) product which could be added to the above list.

Another product which could be added is passion fruit juice. This fruit can be grown in the same area as citrus, and the plants bear fruit all year. Passion fruit juice is a relatively heat-sensitive product. Juice quality benefits from the same high-temperature, short-term type of evaporation planned for citrus juices, so the same equipment could be used for concentrating the juices.

Given the rather small West African market we found for fruit juice, and for concentrated fruit juices, the success of such a project would likely hinge on export markets.

#### Location

A coastal location, close to citrus production areas, would be appropriate for the processing plant. Most of the West African littoral, from the Casamance region of Sénégal to eastern Nigeria, would thus be suitable. A site close to a large urban area would be desirable to facilitate delivery of products to local beverage bottling plants, all of which

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1. SODEFEL, Projet de Création d'un Complexe Agro-Industrial dans la Région de Daloa-Séguéla, Abidjan, June 1978.

are located in major cities, and to reduce transport and handling charges on products to be exported.

The producer should directly control a major portion of the raw material supply. Governments in some areas have sponsored cooperative production schemes, which should be investigated as a supplementary source of supply. The existence of orchards already in production would obviously accelerate the project.

### The Process

Existing processing plants of basically similar type in West Africa are using Italian equipment which extracts oil and juice from the fruit in separate steps at the rate of about 3 tons/hour of raw fruit per line. In a 3-month season of 3 shifts/day and 7 days/week, this line would produce about 4,700 tons of single strength juice or 1,600 tons of concentrated juice (45° Brix orange juice).

Equipment typically used in the United States extracts oil and juice in a single operation. A series of individual juice extractor units are used, each capable of processing 3 tons/hour of fruit and recovering approximately 2 tons/hour of juice, plus peel oils.

Juice from the extractors goes through a screening process in a paddle-type finisher, followed by deaeration, pasteurizing, and filling (for single-strength juice).

Concentrated juice is produced by passing the juice through a special evaporator which subjects the juice to a high temperature for a very short time in order to retain

taste characteristics. Aroma recovery is also provided, i.e., the collection of distillate containing volatile flavors in the juice. This distillate (an aqueous solution of essential oil) is returned to the juice after concentration.

Concentrated juice for storage or reprocessing is usually chilled and filled into polyethylene-lined steel drums, and is then kept either frozen or at low temperatures until it is used.

Citrus peel oil recovered in the extraction process is usually passed through a filter and then a centrifuge to separate the oil from water. The oil may be used to add flavor to the juice, but it can also be filled into plastic drums and sold to bottling plants to make flavor concentrates for carbonated beverages.

#### Raw Material Supply

It is envisaged that citrus plantations would be established to supply the processing plant. These should be planted using approved varieties under the direction of the technical staff of the processing plant or other qualified persons.

Planning for the citrus project in the Daloa-Séguéla region of the Ivory Coast (referenced above) illustrates one approach to a project of a type combining both fresh fruit marketing and processing. It is proposed that an area of 1,050 ha be planted for this project, consisting of 500 ha of limes; 500 ha of mixed oranges, pomelo, and tangelos; and 50 ha of passion fruit. Of this area, 450 ha would be an "industrial plantation" attached to the processing plant,

and 600 ha would be planted by individual farmers (probably organized into a cooperative). The production scheme would be as follows:

	Area (ha)	Production (tons)	<u>Processing</u>		<u>Sold fresh</u>	
			<u>Tons</u>	<u>Products</u>	<u>Tons</u>	<u>Market</u>
Limes	500	11,000	1,000	Juice, oil, pectin	10,000	Europe
Orange, pomelo tangelo	500	12,500	7,000	Juice, oil, pectin	5,500	Local
Passion fruit	50	500	500	Juice	---	---

According to this plan, fruit would be delivered to the plant as follows:

- . Citrus fruit, main season - November, December, January;
- . Citrus fruit, secondary season - June, July; and
- . Passion fruit - August, September, October.

This schedule would permit operation for approximately 8 months of the year. The addition of other fruit, such as papaya and mango, could extend the season even further. Although these fruits require different juice extraction methods, they could be concentrated in the same evaporator.

#### Further Study Required

A study is needed to establish the feasibility of one or more citrus processing plants in West Africa. Objectives of the study would be to:

- . Determine the size of the market and market trends for citrus juices and oils in West Africa, Europe, and the Middle East, including markets for fruit juices, flavor concentrates for beverages, and essential oils for flavoring;
- . Establish plant size and characteristics required to serve the market, taking into account long-term trends;
- . Develop investment and operating cost estimates for processing units and fruit plantations, and determine their financial viability; and
- . Identify suitable locations for such projects.

The necessary points to be studied have been incorporated into the Terms of Reference for the prefeasibility study proposed in Section E.

### Industry No. 3: Regional Reprocessing/Packaging

#### Introduction

Closely linked with the two preceding projects is the regional reprocessing/packaging plant. As was illustrated in Exhibit I-9 above, these facilities would receive, store, and process tomato paste and both single-strength and concentrated fruit juices. Packaged products for consumer sale in the ECOWAS region would be tomato paste in cans or tubes, and fruit juices, nectars, and drinks in cans, cartons, or pouches.

The packaging plant might be a joint investment by operators of the primary processing plants (Industries No. 1 and 2), who act as suppliers. Other shareholders might include principal export customers for the concentrated juices in Europe or the Middle East, and local importers,



distributors, or marketers of food products, especially those dealing in similar products.

### Markets

Canned tomato paste produced by the packaging plants would be sold entirely in West Africa. We have estimated that there is an unsatisfied demand for roughly 43,000 tons of paste in the ECOWAS region. The proposed centrally located packaging plants would ship paste throughout the region by road, rail, or sea.

The plants would also serve the small West African market for packaged fruit juice, currently about 13,000 tons,<sup>1</sup> and would serve as storage and shipping points for bulk concentrated juice intended for export. The size of this export market remains to be determined.

### Location

Regional packaging plants should be located in principal port cities to:

- . Minimize the handling of imported machinery and process supplies such as containers or container materials, chemical preservatives, spare parts, fuel, etc.;
- . Be near major urban consuming areas;
- . Minimize transport costs for packaged products shipped to other ECOWAS countries by sea and for bulk-packaged products for export; and

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1. We estimate that no more than 1,000 tons of this demand is currently met by locally produced juices. The balance is imported, although some imports are shipped in bulk and packaged locally. These existing plants must be taken into account in planning for any new facilities.

- . Be near a labor pool most likely to have the skills needed to operate complex machinery.

The two largest urban areas with extensive port facilities -- Lagos and Abidjan -- are obvious possibilities, although port and urban congestion might dictate locations at smaller West African port cities such as Cotonou, Lomé, Accra, Monrovia, or Freetown.

The choice of location would also be affected by available transportation links to the interior for the receipt of bulk paste and the shipment of canned product. Abidjan is well placed in that it benefits from the railroad to Upper Volta, as well as good highways within the Ivory Coast. The Dakar-Bamako Railway and the good road connections between Dakar and the Sénégal River Valley areas are points favoring Dakar, although the city is somewhat remote from the major consuming centers of ECOWAS.

In addition to the above considerations, the final choice of location would clearly be influenced by the stage of economic integration achieved by ECOWAS when the project is launched, which in turn would be influenced by economic conditions in West Africa.

#### Delivery and Storage of Raw Material

The packaging plant would receive tomato paste and fruit juices in bulk containers during a 6- to 8-month period, and eventually a 10-month period might be possible. A major investment in cold storage facilities would be required to store up to a 6-month supply of both tomato paste and fruit juice to allow year-round utilization of separate packaging lines for these products.

The bulk containers would include 25 kg bag-in-boxes of tomato paste, and 200 liter polyethylene-lined drums of fruit juice.

### The Process

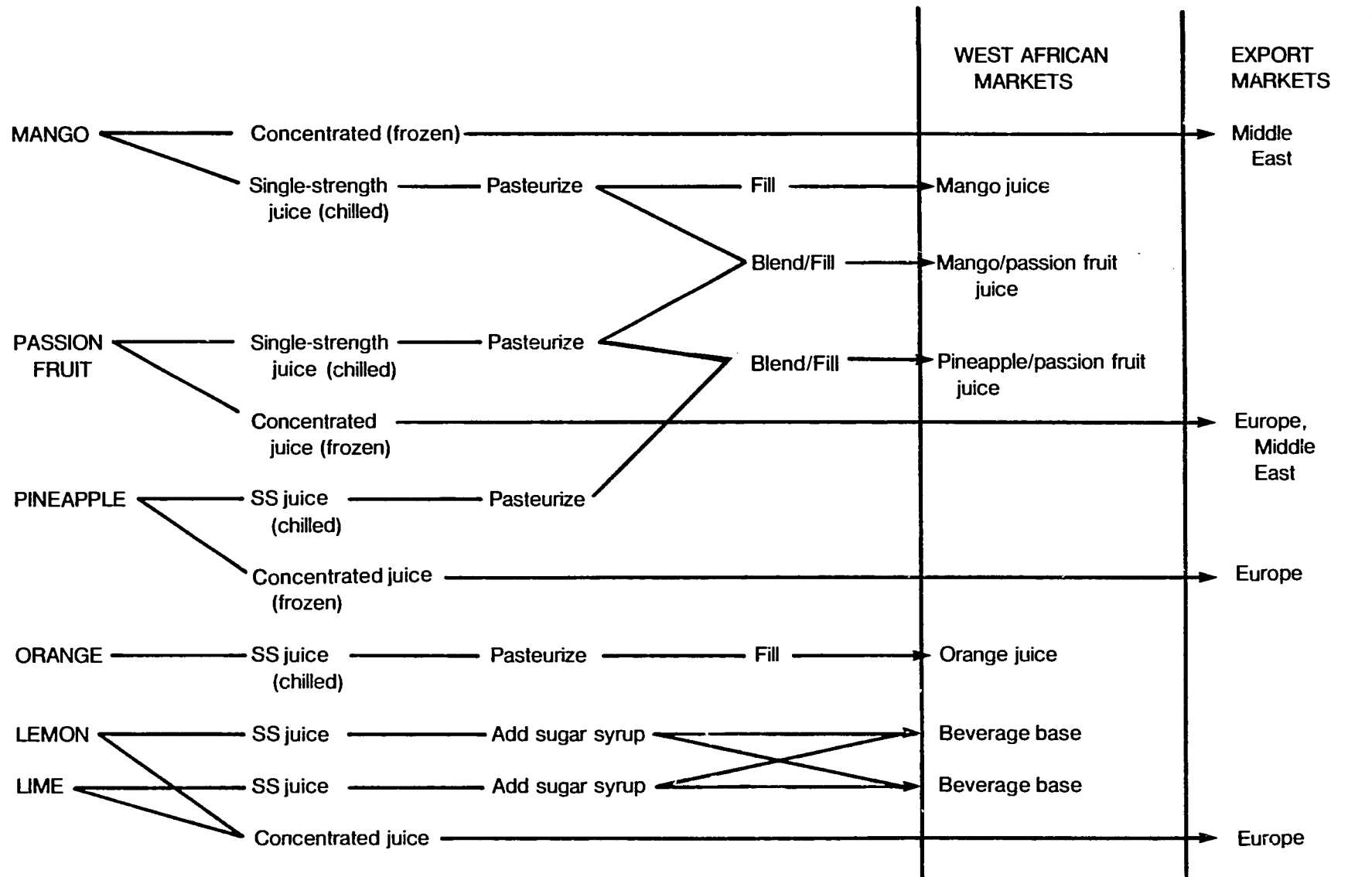
Tomato paste from bulk storage would be reheated to sterilize the product and would then be filled hot into containers, either 70 gm cans or plastic tubes of similar capacity. Study would be required to determine which container is most suitable and cost effective. Cans are being manufactured from imported tinplate in several cities (for example, Abidjan and Dakar), but they are costly and should be compared to other alternatives.

Market studies would be needed to indicate the most desirable mix of fruit juice products. These might include:

- . Single-strength fruit juices, or nectars made from single-strength juice;
- . Fruit beverages made by dilution of concentrated juices;  
Fruit syrup made from juices; and
- . Beverage bases made from concentrated juices.

These would be made from tropical fruit juices (Industry No. 1) and from citrus juices (Industry No. 2), and could also include pineapple juice purchased from processors in the Ivory Coast and Guinea. The juices could be packed pure or in blends (passion fruit/pineapple is one such blend already being produced in the Ivory Coast). These alternative processes are illustrated in Exhibit I-11.

**EXHIBIT I-11**  
**FRUIT JUICE PACKAGING PROCESSES**



A variety of containers is available and a study should be made to determine which is most cost effective. They include cans with tab openings, bottles, cartons (such as Brik-Pak or Tetra-Pak), and gusseted pouches.

The process for fruit juice would involve basically mixing and pasteurizing the juices, and filling and closing the containers. Although the process is simple, the machinery can be complex and expensive, especially if containers are used which involve the form-fill-seal process (cartons, pouches). Experienced technicians would be required to maintain equipment such as this.

A major part of the total investment would be in cold storage. To ensure year-round three-shift operation of the packaging lines, storage space should be provided for a 6-month supply of each product to be processed.

In addition, it would be desirable to use these cold stores as staging points (temporary storage) for bulk-packaged concentrated juices produced by the primary processing plants and intended for export. No reprocessing or packaging would be involved, but the packaging plant's location in port areas would make it a logical site for storing the product prior to shipping, and for storing empty containers. Products which would be so exported are indicated in Exhibit I-11.

This arrangement would obviously be facilitated by joint ownership of the two types of plants.

Number and Size of Plants

A typical tomato paste canning line would operate at 200 cans/minute. Assuming three-shift operation for 260 days/year, the line could pack annually 5,250 tons of paste in 70 gm cans. Two lines would be recommended, handling a total of 10,500 tons. This is the output of 2.5 processing plants of the type described under Industry No. 1 operating at full capacity (4,000 tons). Based on the suggested establishment of 10 new paste plants of this type, four centrally located packaging plants would be indicated. Alternatively, three packaging plants of larger capacity (three lines) would suffice.

Note that the above is based on canning, as is presently practiced in West Africa; further study may prove that packaging in tubes is economical.

As to fruit juice, a single canning line for 6 oz (177 ml) cans of juice, operating at 200 cans/minute on the same basis as above (260 days/year, 24 hours/day), could process 13 million liters/year of single-strength juice (130,000 hectoliters, or 13,000 tons). This would equal the entire estimated annual demand for fruit juice in West Africa. If 12 oz cans (355 ml) were used, capacity would be 26,000 tons.

From the foregoing we see that a separate canning line for fruit juice would not be justified, as it would be infeasible to bring the whole of West Africa's production of juice to one location. A better alternative would be to utilize tomato paste canning lines intermittently for fruit juice. Depending on market factors and the supply situation, frozen or chilled juice would be brought from cold storage,

and one of the two paste canning lines changed over to the proper can size for juice. As noted elsewhere, canning is not necessarily the most desirable package from a cost point of view.

As demand for packaged fruit juice in West Africa grows, a separate packaging line may become feasible.

#### Investment Costs

The equipment required for a reprocessing/packaging plant would consist of two canning lines for tomato paste (and fruit juice), mixing and blending equipment for fruit juices and sugar syrups, and cold storage facilities.

Canning lines would consist of a pasteurizer, various tanks, piston filler, can closing machine, sterilizer, cooler, can labeler, and semiautomatic caser. The cost of this equipment would be about US\$550,000 installed for a 200 can/minute line. Two lines would cost US\$1.1 million. Mixing and blending equipment would cost roughly US\$100,000, for a total equipment cost of US\$1.2 million.

The cost of cold storage facilities, including refrigerator equipment, is highly sensitive to capacity requirement, which is not possible to estimate at this time. Costs could range from US\$100,000 to US\$300,000. Other costs would include building fixtures and furniture, which would run between US\$200,000 to US\$300,000.

Total investment costs would thus be on the order of US\$1.5 to US\$1.8 million, excluding engineering design and start-up costs. The addition of the latter would raise total project costs to between US\$1.6 and US\$2.0 million.

These figures assume that electric power generating facilities would not have to be provided, given the urban location of the plant.

#### Further Study Required

The analysis required to establish the feasibility of this project is clearly linked to that of Industry No. 1, and should be carried out in conjunction with it. We have incorporated the necessary points into the general Terms of Reference included in the following section.

#### Summary

Three separate but interrelated processing industries are identified as being potentially feasible. These are:

- . Tomato and fruit processing plants, at inland locations suitable for tomato growing, producing tomato paste and tropical fruit juices (single-strength and concentrated) packaged in bulk for shipment to reprocessing/packaging plants;
- . Citrus fruit processing plants located in coastal regions of West Africa where citrus fruit is grown, producing concentrated citrus juices and essential oils for West African carbonated beverage bottlers and fruit juice packagers, and for markets in Europe and the Middle East;
- . Regional reprocessing/packaging plants centrally located in West African port cities and supplied with bulk-packaged tomato paste and fruit juice from the above two industries. The plants would package these products for West African consumers on a year-round basis and also ship concentrated juice from storage to foreign customers.



I-91.

Further investigation, beginning with an analysis of export and local markets, is required to establish the preliminary feasibility of these industries.

## E. RECOMMENDATIONS

### Introduction

This section draws on our findings in preceding sections to describe some specific actions which ECOWAS could take to further the development of regional fruit and vegetable processing industries.

Our principal recommendation concerns the promotion of three interrelated types of tomato paste and fruit juice processing and packaging industries. Second, we urge the development of wheat flour substitutes from locally grown cassava and plantain. Third, we suggest further development of vegetable dehydration techniques.

Our recommendations to ECOWAS are based on our understanding of the types of activities foreseen for this organization in its charter. These activities could include:

- . Sponsoring of project-identification, prefeasibility, and feasibility studies for projects which emphasize regional cooperation;
- . Promotion of investment through the circulation of feasibility studies to private investors, to international lending and investment organizations, and to ECOWAS member governments;
- . Holding of seminars and conferences with similar objectives;
- . Coordination of research having broad application to ECOWAS member countries; the reporting of research findings through published reports and conferences;
- . Continued work to increase intraregional trade through the reduction of tariffs and the removal of other trade barriers;

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- . Joint planning of industrial development, including sharing of processing facilities on a joint investment basis;
- . Exchange of information in such areas as crop variety trials and new food processing or preservation techniques; and
- . Encouraging or assisting in the negotiation of bilateral and multilateral agreements involving trade in specific semiprocessed or finished products.

All of these activities are relevant to our recommendations and, as will be seen below, would contribute greatly to their successful implementation.

#### Tomato and Fruit Processing and Packaging

It was our purpose in the preceding section of this report to identify potentially feasible fruit and vegetable processing industries in the region. A basic concept consisting of three interrelated processing units was presented. Further study is needed, however, before the establishment of such plants could be recommended; this work would be in the nature of a prefeasibility study.

Examples of the types of questions that will need to be answered are:

- . How can the production of tomatoes best be organized in the various locations being considered? If cooperatives are preferred, how can they be linked organizationally to the factory? What are farm development costs expected to be, and how should these costs be financed, i.e., what government support can be expected?
- . What are the expected costs and returns from "satellite" tomato and fruit processing

plants as proposed in this study, i.e., how large do they need to be to break even under various assumptions about selling prices?

- . What kinds of fruits are (or can be) available in the vicinity of the processing plant? What would it cost to establish orchards to produce them? What effect does fruit processing have on the profitability of a tomato processing plant (by extending the processing season)?
- . What are current trends in fruit juice consumption in West Africa? What kind of package is most cost effective?
- . What formulations are in use for citrus flavor concentrates for carbonated beverages in West Africa? If these concentrates were to be locally produced, would it be done by the bottler or by the juice producer, and what would the cost be? How will this market grow in the future?
- . What are market trends in Europe and the Middle East for tropical fruit juices, citrus juices, and citrus oils? What are current prices and how competitive can West African producers be?

Once these and other relevant questions are answered by means of the recommended study, ECOWAS could make the report available to potential investors or lenders via member governments, or directly through a conference to which interested parties could be invited. Other concrete promotional measures that ECOWAS could undertake include the sponsoring of bilateral and multilateral agreements regulating trade in semiprocessed products (bulk tomato paste and fruit juice) and finished package juice and paste; the harmonizing of investment incentives; and the sponsoring of multilateral investment agreements for processing plants.

As a basis for such a prefeasibility study, we offer the draft Terms of Reference contained in Exhibit I-12.

### Composite Flour

In our discussion of markets for composite flour, we reviewed research work currently in progress and pointed out that up to 20 percent of the enormous imports of wheat used in baked goods in West Africa could be replaced by locally available food crops such as cassava and plaintain. We noted that 20 percent of value of these imports in 1981 could amount to US\$78 million. To underscore the importance of this point, the Ivory Coast imported tomato paste in 1982 worth roughly US\$7 million, whereas wheat imports in 1981 were worth US\$55 million. If 20 percent of this wheat had been replaced by local materials, the savings of US\$11 million would far exceed those from reaching self-sufficiency in tomato paste.

We recommend that immediate priority attention be given to the development and processing facilities for cassava and plaintain flour and that, as this flour becomes available, millers in West Africa be required to mix it with flour from imported wheat in increasing quantities until it reaches 20 percent by weight of the total.

Specific steps which are recommended for ECOWAS are described in the following paragraphs.

Exhibit I-12. Terms of Reference:  
Prefeasibility Study of  
Tomato and Fruit Processing and Packaging

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Purpose: To determine preliminary feasibility of tomato and fruit juice processing and packaging industries in ECOWAS member countries based on an integrated regional structure. This structure would involve regional dispersed primary processing units of two types supplying central packaging or reprocessing units.

Scope: The study will require on-the-spot investigation of West Africa European, and Middle East markets for products, as well as a survey of existing West African processing plants and planned new projects. Findings, which must be suitable for presentation to potential investors in such projects, should include: projected production by product, according to form and type of container, to meet market demand; estimated costs and selling prices; investment levels; and number, size, and approximate location of plants to be built.

The study should consider the three types of processing plants proposed in the present study:

- . Tomato paste and tropical fruit juice processing;
- . Citrus juice and citrus oil processing; and
- . Reprocessing/packaging of tomato paste and fruit juice.

Personnel and Time Required: It is estimated that a total of 10 man-months would be needed to complete the study, and that the following personnel would be required:

- . Food Marketing and Processing Specialist: 4 months
  - . Agronomist: 3 months;
  - . Food Processing Engineer: 2 months; and
  - . Financial Analyst: 1 month.
- 

(Continued)

Exhibit I-12 (Continued).

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It is anticipated that of the total of 10 man-months, approximately 6 would be spent in the field. The study would be completed within 6 calendar months from the contract date. The study should include, but not necessarily be limited to, the following points:

I. Background

- A. Review findings in the present study.
- B. Review relevant documents to be made available by ECOWAS member governments, including feasibility studies, market studies, and other project planning documents (some of these are listed in the bibliography in this study).

II. Market Analysis

Prepare survey, which should include 10-year projections of demand by product type and by country, of the following markets (the study should update or complete the market analysis in the present study):

- A. West African market for tomato paste.
- B. West African market for packaged fruit juices, nectars, and syrups prepared from citrus, mango, pineapple, papaya\*, passion fruit, and guava.
- C. West African demand for citrus flavored concentrates for bottled carbonated beverages, translated into demand for concentrated citrus juice and citrus oil.

\*Recent approval by the U.S. Food and Drug Administration of an enzyme derived from papaya called chymopapain as a substance to dissolve damage spinal discs opens an interesting new market which should be explored.

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(Continued)

Section 1-11 (Continued)

2. Europe and Middle East markets for tropical fruit juices in the form of single-strength juice or concentrated juice. Contact with importers and processors/packagers of these products will be needed to determine the type and form of products used, containers required, seasonality of demand, etc., and available statistics on consumption and imports will need to be reviewed. Products include mango, passion fruit, papaya, guava, and pineapple juice.

3. European and Middle East markets for citrus juice concentrate and citrus oils. Contact with importers and buyers of these products, such as beverage bottlers and the confectionery and cosmetic industries, will be required.

The survey should include an analysis of world sources of supply, production trends, and price trends, and should project market shares potentially available to West African producers at stated prices.

### III. 1.12. Production

A. Survey ECOWAS region to determine locations with available soil and water resources for growing tomatoes. The survey would concentrate on areas known to be suitable for tomatoes but not yet being exploited, such as parts of Togo, Upper Volta, Niger, and Mauritania, and would utilize existing feasibility studies made available in advance by ECOWAS member governments.

(Continued)



Exhibit I-12 (Continued).

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- B. Survey availability of tropical fruit (mango, papaya, pineapple, passion fruit, guava), especially in areas determined to be suitable for tomatoes, including feasibility of starting orchards where none now exist. If selected areas are unsuitable, determine feasibility of transporting fruit from other growing areas.
  - C. Survey citrus production in coastal regions of West Africa, with emphasis on varieties, yields, and systems for organizing production (such as cooperatives).
  - D. Recommend systems for organizing crop production, taking into account government policies in the countries concerned regarding private enterprise and cooperatives and the need for reliable and regular deliveries to processing plants.
  - E. Survey transportation and communications facilities in the selected growing areas, especially links to coastal West African cities.
  - F. Recommend suitable varieties for processing based on market demand (see II above).
  - G. Estimate investment costs to establish irrigated tomato farms and fruit orchards.
  - H. Estimate crop production costs per kg, or buying prices from growers, based on costs for fertilizer, seeds, chemicals, farm labor, equipment, as well as operating and maintenance costs, etc.
  - I. Recommend suitable locations for tomato/tropical fruit processing plants and for citrus processing plants.
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(Continued)

Exhibit I-12 (Continued).

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- J. Prepare estimates of crop production and deliveries over first 10 years of project life.

IV. Processing

- A. Complete survey, begun in the present study, of existing fruit and vegetable processing plants in West Africa. These should include plants which are not now operating (see present study) to determine feasibility of renovation, i.e., usability of equipment and buildings, ownership, status of existing farms or orchards, and problems experienced in the past.
- B. Based on market and crop production studies above, and on capacities of existing plants, recommend appropriate processes, and equipment types and capacities, for three types of plants:
- . Tomato/tropical fruit juice processing plants.
  - . Citrus juice/citrus oil plants; and
  - . Tomato paste/fruit juice reprocessing/packaging plants.
- C. Prepare investment cost estimates for above plants, including processing equipment, auxiliary equipment, buildings, utilities, and necessary storage, including cold storage.
- D. Estimate unit production cost for each type of product based on desirable delivery schedules for raw or semiprocessed materials.
- E. Recommend suitable consumer packaging and storage/shipping containers for all products.
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(Continued)

Exhibit I-12 (Continued).

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V. Financial Projections (for each type of plant)

- A. Project sales revenues for 5 years by product.
  - B. Develop projected investment costs, amortization schedule.
  - C. Project operating costs.
  - D. Develop projected 5-year profit and loss statement.
  - E. Estimate return on investment.
-

### Sponsorship of a Conference

A conference should be organized on the present status of research and development of wheat flour substitutes, especially to include the following work by the named institutions:

- . Production of flour and other products from cassava by the Ivoirienne de Technologie Tropicale (I2T) at Toumodi, Ivory Coast;
- . Production of composite flour from cassava and wheat flours by the Federal Institute of Industrial Research, and work on cassava by the National Root Crop Institute, in Nigeria;
- . Production of composite flour from plantain and wheat flours by the National Horticultural Research Institute and the Federal Institute of Industrial Research, Nigeria; and
- . Studies on substitution of millet and sorghum flours for wheat being coordinated by the Institut de Technologie Alimentaire, Dakar, Sénégal.

In some cases, research results may be considered proprietary and available only under license agreements. If so, licensing arrangements could be explored at the conference and the interested parties brought together.

The possibility of using imported or local soy flour as an additive to increase protein content should also be examined.

### Dissemination of Information

The conference should result in a comprehensive report for circulation among member states on the status of research

and development on composite flour. It should give preliminary indications of the feasibility of establishing processing plants. If available information is insufficient to do this, ECOWAS may want to commission a study to assemble and evaluate the available data.

#### Establishment of Policies

ECOWAS could convene a technical conference to establish common specifications for composite flour, including percentages of various wheat flour substitutes based on baking tests. Varieties of cassava and plantain suitable for processing would be specified. The possible use of additives such as soy flour would also be considered.

#### Investment Promotion

ECOWAS could promote private and public investment in manufacturing of flour substitutes by circulating available studies and information on licensing arrangements, by sponsoring a conference of potential foreign and local investors, and by harmonizing special investment incentives for this important industry.

#### Vegetable Dehydration

To our knowledge, work is currently being carried out on vegetable dehydration at two levels:

- . In Nigeria, at the National Horticultural Research Institute, research is being conducted on the processing technology for drying okra. This is a small-scale industrial process involving slicing of the okra, the addition of salt, and then drying on trays with a controlled stream of heated air. The

dry product is intended to be ground and packaged in paper envelopes as a soup stock ingredient. It is claimed that the process retains the color and mucilage content of the fresh product, and is more sanitary than traditional methods. The process has been perfected in the laboratory and is ready for testing on a commercial scale. Similar techniques could be used for vegetables.

- . In Sénégal, USAID has sponsored studies of a "village solar dryer" made almost entirely from local materials at a cost of under CFA 5,000. The work, being carried out by a USAID contractor, Miss Janis Timberlake, draws in part on work at the Institut de Technologie Alimentaire in Dakar. The USAID-sponsored work has extended to construction of solar dryers by villagers in one area of the country and experiments with a variety of fruits and vegetables.

Both these efforts have as their basic objective the preservation of vegetables which might otherwise be lost to spoilage. Further work needs to be done on costs, quality of the product, and its acceptability to consumers.

In view of the large losses of perishable vegetables occurring in West Africa, we believe that ECOWAS should consider sponsoring a study to assess the potential of simple dehydration methods for increasing food supplies in the region. The first phase should be a review of results of research on dehydration methods of all types, including costs and acceptability. This may indicate the direction of further research to answer unresolved issues. To be widely used as a soup ingredient, dried vegetables would have to be cheap to make and cheaply packaged.

Summary

We recommend the active promotion of tomato paste and fruit juice processing and packaging industries because of the potential for import substitution and export sales of these products, and because of the regional character of these industries. A specific step which is recommended is the sponsorship of a preliminary feasibility study of three separate but interrelated industries:

- . Tomato and fruit processing plants, at inland locations suitable for tomato growing, producing tomato paste and tropical fruit juices (single-strength and concentrated) packaged in bulk for shipment to reprocessing/packaging plants;
- . Citrus fruit processing plants located in coastal regions of West Africa where citrus fruit is grown, producing concentrated citrus juices and essential oils for West African carbonated beverage bottlers and fruit juice packagers, and for markets in Europe and the Middle East;
- . Regional reprocessing/packaging plants centrally located in West African port cities and supplied with bulk-packaged tomato paste and fruit juice from the above two industries. The plants would package these products for West African consumers on a year-round basis and also ship concentrated juice from storage to foreign customers.

We further recommend that priority attention be given to developing substitutes for wheat flour which could be used in proportions of up to 20 percent in baking. Such substitution could reduce the large imports of wheat by as much as US\$78 million based on 1981 imports. Considerable research and development has already been done on flour produced from cassava and plantains, as well as from other

grains and tubers. A coordinated approach by West African states to speed the development of this process could be sponsored by ECOWAS.

Research has also been done on the dehydration of vegetables, a process which offers possibilities of reducing the large losses caused by spoilage of perishable crops. Here also we recommend that ECOWAS assume the role of coordinator, and possibly of sponsor, of further research and development.



**PART II**  
**COUNTRY SURVEYS**

## PART II COUNTRY SURVEYS

This part of the report contains surveys of fruit and vegetable production and processing in the seven countries visited. It serves both as a record of our findings and as background for Part I.

The amount of information presented in this part varies considerably from country to country because of the relative degree of access to responsible individuals, to data, and to relevant documents that was gained within the limited time available for the survey. Furthermore, three of the seven country surveys (Nigeria, Sierra Leone, Mauritania) were conducted by only one member of the team, which restricted survey coverage in those areas.

With several exceptions, then, information in the country surveys is presented under the following five headings:

- . General Observations
- . Production
- . Processing Facilities
- . New Project Planning
- . Research.

## A. THE IVORY COAST

### General Observations

#### The Natural Environment

For the most part, the Ivory Coast has a tropical, rainy climate, with rainfall ranging from 1,500 mm in the south to 1,000 mm in the north. Its soils are fairly rich. The country is predominantly agricultural and produces a wide variety of tropical crops.

The distribution of foodcrops varies widely according to the specific general diet of each region of the country. However, due to urbanization, blending of populations, and progress, an Ivorian's basic diet at present consists of the following four foods: rice, plantain, yams (igname), and cassava (manioc). Since these crops are produced in large quantities in both the Ivory Coast and other countries -- as will be seen later -- they have been included in the study.

Foodcrops produced and consumed in the Ivory Coast will be considered as falling into three categories:

#### . Fruit:

- . plantain and sweet banana;
- . pineapple;
- . citrus fruits: orange, mandarin (tangerine), lemon, grapefruit, lime, bergamot orange;
- . cashew;
- . mango; and
- . avocado, papaya.

. Vegetables:

- . traditional vegetables: eggplant, pimento, okra (gombo), cowpea;
- . temperate-climate vegetables: cabbage, leek, bellpepper, squash, lettuce, cucumber, potato, snap bean;
- . soybeans and peanuts (groundnuts); and
- . tomato.

. Starchy foods:

- . cereals: rice, maize (corn), sorghum (guinea corn); and
- . tubers: yam (igname), cassava (manioc), cocoyam (taro).

Form of Consumption

Fruits

Fruits are generally consumed fresh for dessert: sweet banana, pineapple, citrus fruits, mango, avocado, papaya. For the most part, these fruits are consumed by urban dwellers.

Plantain is eaten in both urban and rural areas in a variety of ways:

- . Foutou: with a sauce;
- . Alloko: fry-up of ripe banana branch, seasoned with pimento, fish, and salt;
- . Purée; and
- . Paste: ripe banana, mashed and mixed with cassava flour.

Most fruits are consumed fresh; for example, 80 percent of mango production is eaten fresh. Other fruits are industrially processed and consumed as canned fruit:

- . Pineapple: juice, slices, heavy and light syrup;
- . Mango: juice, pulp;
- . Cashew: as a nut; and
- . Citrus fruits: juice, marcpectin for feed, and essential oils for the cosmetics industry.

### Vegetables

Traditional vegetables are generally consumed raw or dried and are used as a condiment in sauces. Temperate-climate vegetables (sometimes referred to as imported vegetables) tend to be consumed in urban areas, in their fresh state.

Soybean is still in the introductory stage in the Ivory Coast, although it is being produced in significant quantities. Current soybean production in the Ivory Coast is used for animal feed or exported as a cereal.

Peanuts for human consumption are eaten raw or dried. They are an ingredient in sauces, and are consumed as salted or caramel cakes. At the TRITURAF plant in Bouaké, peanuts are processed for their highly regarded table oil. The press cakes are used for manufacturing animal feed.

Tomatoes are also eaten fresh, either directly or in sauces. They are also available in processed form, as juice and as concentrate.

### Starchy Foods

In the Ivory Coast, tubers are consumed in various ways:

- . Foutou, gruel, and purée: traditional way of preparing tubers;
- . Attiéké, gari, flour: produced in both homes and mills;
- . Placale: cassava paste prepared by grating the fresh unfermented root; and
- . Fried: yams.

As regards cereals, their form of consumption is not noteworthy in the Ivory Coast, except for maize (corn) which is used in the north for the manufacturing of a local beer called dolo. Cereals are an essential constituent of cattle and poultry feed.

#### Geographic Distribution

For purposes of simplification, we have divided the Ivory Coast into three parallel east-west bands:

- . The South: A band having as its upper limit the east-west line through Toumodi;
- . The Center: This band lies between Toumodi and Katiola; and
- . The North: The band north of Katiola.

Because of their specific climate and soil conditions, these zones are not suitable for all crops. We have therefore proposed the following distribution corresponding to current production areas:

- . In the South: banana, pineapple for canning, avocado, citrus fruits, papaya, eggplant, pimento, okra (gombo);
- . In the Center: almost all crops except plantain and cocoyam (taro);

- . In the North: mango, cashew nut, soybean, peanut (groundnut), yam, rice, maize (corn), sorghum, tomato, vegetables.

### Production

#### Institutional Organization of Production

#### Intervention by the Government

At the national level, the State Secretariat for Agriculture is charged with coordinating foodcrop production. Although only recently established, the State Secretariat for Agriculture has an executing arm with many years of experience, i.e., SODEFEL (Société pour le Développement des Fruits et Légumes -- Fruit and Vegetable Development Corporation). SODEFEL's activities involve the producing, processing, and marketing of fruit and vegetables. It is charged with instructing and assisting individual farmers engaged in fruit and vegetable production. As part of the crop diversification policy and for agronomic reasons (i.e., the need for crop rotation), SODEFEL has come to grow rice, maize (corn), and yam in its Sinématiali and Koubi vegetable farms at Tiébissou.

SODEFEL's mandate as regards fruit and vegetable production has been given concrete expression in three types of operations:

Small urban market gardens (Petits Périmètres Urbains - PPUs). Small urban market gardens range from 1 to 20 ha and are situated in the vicinity of towns and cities, generally in small low-lying areas (bas-fonds). These gardens are manually irrigated with watering pots. Several small growers, each owning 10 to 20 acres, are grouped together in each

market garden. These growers form village cooperatives (GVC -- Groupement à Vocation Coopérative) for the marketing of their products.

SODEFEL's role as regards PPUs can be summed up as technical training and assistance to farmers as well as marketing of fresh vegetables.

PPUs are sometimes equipped with a small hilltop reservoir which supplies them with irrigation water throughout the year. Such is the case with the market garden at N'Dakro, which has 13 ha developed; its complete hydraulic equipment allows the growers to practice sprinkler irrigation.

Yields obtained on PPUs are often low because growers ignore the advice given by extension agents: tomato, 15 tons/ha; eggplant, 5 tons/ha; cabbage, 10 tons/ha; okra (gombo), 6 tons/ha. Major PPUs have been developed at Gagnoa, Rubino, N'Dakro and N'Zi, having a potential production of 15,000 tons of vegetables by 1985.

Large truck farms (grands ensembles maraîchers).

Large truck farms are located at Marabadiassa (east of Bouaké), Koubi, and Tiébissou. These truck farms cover approximately 100 ha. They are equipped with a dam and irrigation system, and can be either single-crop (tomato) or multiple-crop (fruit and vegetables) such as the farms at Marabadiassa, Koubi, or Touba.

Capital outlays are borne entirely by the Government of the Ivory Coast (GOIV), either with its own resources or with foreign loans.



The plots brought under cultivation are distributed to growers who form cooperatives (GVCs).

Yields obtained in these truck farms are higher than those obtained in PPUs: eggplant, 15 tons/ha; tomato, 25 tons/ha; cabbage, 15 tons/ha; and pineapple, 55 tons/ha.

At a production cost of 50 CFA/kg, pineapple grown at Koubi appears to be a profitable crop.

Agro-industrial complexes. SODEFEL had initially considered the establishment of three agro-industrial tomato production and processing units at Sinématiali, Boundiali, and Bouna. These three units, identical in both the area to be cultivated and size specifications of the plants, would have made it possible fully to cover the country's needs for tomato juice and concentrate. However, only the Sinématiali unit could be built with Ivorian financing for a total of CFA 5 billion. (A thorough discussion of its processing operations is given in Appendix A.)

#### The Role of Private Firms

Private firms have involved themselves mainly in the production and processing of fruits: banana, pineapple, and citrus fruits. Thus, the SAFCO company at Tiassalé and the SALCI company at Ono grow fresh pineapple and produce pineapple juice and heavy syrup (a third firm, La Nouvelle SIACA at Bonoua, also processed pineapples until financial difficulties forced its recent closure). For its part, Consortium des Agrumes de Sassandra grows and processes lemon, bergamot orange, and bigarade. (See Appendix A for a thorough discussion of the processing operations.)

National Production  
Level and Overall Needs

Fruits

Except for pineapple and banana, there are few statistics on the national production of fruits because of the lack of organized collecting and marketing channels. Current production of poyo bananas is estimated at 104,000 tons, and of plantain bananas, at 1,200,000 tons. Pineapples are grown in the south and southwest. An estimated 100,000 tons are produced annually for the fresh export market.

Given its favorable climate and soil conditions, the Ivory Coast has a tremendous potential for fruit production. Most tropical fruit trees are grown with varying degrees of success throughout the country, except for banana, whose area of cultivation appears to be limited to the forest. For the following fruits, bioclimatic conditions favor excellent yields in specific areas:

- . Banana (poyo banana): south and southwest (from San Pedro to Bassam);
- . Plantain: the whole forest region except marshy lands;
- . Citrus fruits and mango: north and center; and
- . Avocado: forest area and center.

However, fruit tree development is limited despite efforts undertaken by SODEFEL, which has established orchards, nurseries, and research stations at Séguéla, Bouaké, Korhogo, Bingerville, and Katiola. Indeed, without an adequate system for collecting and marketing the fruit at prices which exceed production costs, and without the establishment

of processing plants and packing houses, it would be futile to expect an increase in fruit production, despite the Ivory Coast's tremendous potential in this area.

Under present conditions, a large proportion of the citrus fruits, mangoes, and avocados consumed locally are harvested from trees grown on coffee and cocoa plantations. In such cases, yields are irrelevant since these trees are widely dispersed.

Production is heavily influenced by post-harvest losses caused by poor sales of the products: a grower deals with a small trader who in many areas sets his own purchase price and whose transportation means are highly unreliable. His vehicle -- often of low capacity (1-5 tons) and unsuitable for this use -- does not allow him to purchase the farmer's entire output and transport it to consumption centers.

In general, on-farm consumption is fairly low.

#### Vegetables

SODEFEL's extension work on vegetable crops has resulted in their rapid development at the market garden, truck farm, and private plantation levels. Nevertheless, production is far below the level at which the nation would be self-sufficient. Nearly 20,000 tons of fresh vegetables will have to be imported by 1985, as against a 13,000 ton production level projected by SODEFEL. It should be noted that production of local vegetables (okra, pimento, eggplant) is important: although 50 percent of such production is consumed on-farm, the percentage marketed is relatively high considering the high losses incurred because of the poor methods for conserving and storing these products.

Results of research and trials conducted by SODEFEL have made it possible to determine the preferred growing areas for vegetables:

- . Traditional vegetables (okra, pimento, egg-plant): in rainfed cultivation in the south, one cycle; and
- . Traditional vegetables, tomatoes, and imported vegetables (cabbage, lettuce, onions, potatoes): in the center and north of the Ivory Coast; the opportunity exists for two or three cycles with additional irrigation.

As regards tomatoes, which are consumed in large quantities by Ivorians, efforts must be undertaken to develop this production. Present tomato needs amount to 5,000 tons of fresh tomatoes and 10,000 tons of tomato concentrate. Present production yields only 3,000 tons of fresh tomatoes and 1,400 tons of tomato concentrate produced by the Sinématiali complex.

Exhibit II-1 gives the production levels for fruit and vegetable crops supported by SODEFEL for the years 1968-78.

### Tubers

This section gives a brief description of yams and cassava (manioc). Although not classified as fruits or vegetables, these two products are particularly important for all ECOWAS countries because of their geographic distribution and because they are solidly established staple foods in the region.

Yams (igname). Traditionally grown and eaten in the north, the center, and part of the forest area of the Ivory Coast, yams appear to be the most widely consumed foodstuff,

Exhibit II-1. Production of Food Crops  
Supported by SODEFEL  
(metric tons)

Year	Canned pineapple	Fresh pineapple	Bananas	Citrus fruits yielding essential oils	Misc. vegetables
1968	44,500	18,634	136,175		
1969	45,500	22,092	142,259		
1970	60,098	39,500	146,257		
1971	62,632	45,017	171,375	15,740	
1972	73,876	70,996	137,653	23,958	983
1973	85,816	78,278	165,985	23,262	1,019
1974	78,000	71,465	141,213	33,391	1,064
1975	66,032	70,129	99,442	43,847	1,556
1976	92,737	80,000	114,214	47,504	1,801
1977	78,459			31,785	2,398
1978 <sup>a</sup>	95,248				

a. Production figures for 1978 could not be obtained for SODEFEL which, like a number of State Corporations, underwent major reforms which resulted in a decrease of production.  
Source: SODEFEL.

the second most important one being plantain. While production potential is tremendous, conservation and market organization problems remain unsolved at the national level, thus limiting present production to around 2.2 million tons. Despite widely fluctuating prices (CFA 30 to 150/kg) and poor storage methods, there has never been a shortage of this product, not even a seasonal one.

Cassava (manioc). Cassava, which is as common as yams, has spread to all regions of the Ivory Coast. A very undemanding crop, it was traditionally grown in the center and south of the country. It is eaten in the form of foutou, stew, gari, and attiéké. The latter two can be prepared industrially, making cassava a fairly special product.

#### Processing Facilities

Existing processing facilities for fruits and vegetables include:

- . A tomato paste/mango juice plant and associated tomato growing area at Sinématiali (near Korhogo) in the north, operated by SODEFEL;
- . A pineapple processing plant and plantation at Tiassalé in the south, owned by a private firm, SAFCO;
- . A pineapple processing plant and plantation at Ono in the southeast, owned by a mixed state/private firm, SALCI; and
- . A citrus processing plant and associated growers' cooperative at Sassandra in the southwest, producing citrus oils and concentrated lemon juice.

A third pineapple processing plant, La Nouvelle SIACA at Bonoua, recently closed due to financial problems.

Sinématiali Fruit  
and Vegetable Cannery

Since 1979 SODEFEL has operated a processing plant for tomato paste at Sinématiali. The same organization has organized production of tomatoes on an 1,800-ha irrigated area adjacent to the plant. The area is broken into ten blocks, with labor provided by farmers who are being organized into cooperatives and settled on the land. Although development of the area is not yet complete, 9,000 tons of tomatoes were produced on 400 ha in the 1981-82 season. More recently, canned mango juice has been produced from fruit purchased from farmers in the area.

The project has been successful thus far due to good management and close coordination between the processing plant and production area. Until recently, farmers have worked under the close supervision of a French technician and the Ivorian field supervisors he has trained. Mechanized field operations such as land preparation are centrally controlled. Manual operations such as weed control, spraying, and harvesting are organized by the block managers, with teams of workers from among farm families assigned to each block.

The project is now entering a critical phase with the creation of cooperatives, the departure of the French technician, and the turnover of responsibility to the block managers.

Tomato paste in 70 gm cans is marketed in the Ivory Coast where it competes with much cheaper imported paste. Import duties and taxes bring the price of the imported

product to virtually the same level as paste from Sinématiali.

A profile of this project appears in Appendix A.

SAFCO

Located in the southern part of the country, this privately owned firm produces canned pineapple juice and slices for local consumption and for export. Approximately one-quarter of the pineapple supply comes from the company's own plantation, and three-quarters comes from local farmers who receive agriculture supplies on credit as well as some technical assistance from SAFCO. Yields last season were only 40 tons/ha due to lack of rain. Normal yields are about 60 tons/ha.

Last season the firm processed 15,200 tons of fruit and sold an additional 2,500 tons of fresh fruit. Of total sales of pineapple juice, approximately 25 percent was to Europe, 35 percent to neighboring countries, and 40 percent local. Almost 90 percent of the production of pineapple slices goes to Europe, and the remainder is sold to neighboring countries.

SAFCO, along with other Ivory Coast pineapple processors, has been hard hit in recent years by lower cost pineapple products exported to Europe by Thailand and other Asian countries. This has led to temporary subsidies from the Government of the Ivory Coast to all three canners (which did not, however, prevent the closure of La Nouvelle SIACA).



SAFCO also has plantings of passion fruit and processes some juice. A blend of pineapple and passion fruit juices is produced in limited quantities.

A profile of this firm appears in Appendix A.

#### SALCI

The SALCI operation, located in the southeast at Ono, is a mixed government/private firm, with the government holding 22 percent of the shares. Like SAFCO, it has also experienced declining export sales. The plant was temporarily shut down during our stay in the Ivory Coast and was not visited.

Approximately 90 percent of supplies are obtained from private farmers, who receive extension and input services from SODEFEL. SALCI processed 90,000 tons of fruit in 1979. (Plant capacity is said to be 135,000 tons.)

Farmers receive CFA 13/kg (delivered in the field), the price fixed by SODEFEL. At this level profits are very modest, averaging CFA 800/day, which is little more than the daily wage for farm laborers.

#### Sassandra Citrus Oil Project

The Sassandra operation consists of two cooperatives: one composed of planters of citrus fruit; the other, of owners of the processing plant producing citrus oils and juices.

- . COPAGRUM unites 125 planters who grow 3,000 ha of citrus fruit, of which 2,000 ha are lemons, 500 ha bergamot, and 500 ha bigarade.

- . COCI operates the processing plant and is held 68 percent by the planters and 32 percent by a consortium of foreign companies, mostly French.

The plant is equipped with four lines: two for extraction of oil and juice from lemons, and one each for oil of bergamot and oil of bigarade. Lemon juice is concentrated and exported to Europe for use in soft-drink manufacture. The essential oils, also exported to Europe, are used in perfumes, cosmetics, and the bakery industry. The dried fruit pulp is sold for use in animal feeds and for making gelatin.

The industry suffered a severe setback between 1974 and 1978 as prices fell sharply. This led to the abandonment of or failure to replant many plantations, with the result that annual fruit production (24,000 tons) is less than half the capacity of the factory. COPAGRUM plans the creation of a number of new plantations within a 25-km radius of the factory. The concern is already benefiting from the intervention of the government which took place in 1979. Sales increased 80 percent from 1979-80 to 1980-81.

#### New Project Planning

The "Fruit-Vegetable-Plantain Commission," which brings together all government agencies concerned with fruits and vegetables, noted in December 1981 the following objectives concerning processing:

- . Increase production of tomatoes to bring the Sinématiali plant up to capacity before beginning either of the other two planned tomato paste plants (at Bonoua and Boundiali). These two plants would be built in the 1985-90

period, bringing supply and demand approximately into balance.

- . Increase planting of citrus fruit to bring the essential oil plant at Sassandra up to capacity.
- . Create a new processing plant for orange juice at Séguéla (center west region) and establish 500 ha of new orange tree plantations. The project has been studied by the Dutch firm HVA, but the report was unacceptable as the proposed plant was considered too small.

#### Limes and Other Citrus Fruits

A 1978 SODEFEL study proposed a project similar to the one mentioned above for the Daloa-Séguéla area, this one based heavily on limes but also including other citrus fruits and grenadilles (passion fruit). The study proposed that 500 ha of limes would be grown, plus 500 ha of oranges, pomelos, and tangelos and 50 ha of passion fruit.

The limes would be of the Tahiti lime variety, a large green fruit without pits for which a promising fresh market exists in Europe. Of total production, 10,000 tons of fresh limes would be exported and 1,000 tons would be processed into juice and essential oil. Of the 12,500 tons of oranges, pomelos, and tangelos produced, 7,000 tons would be used for juice and oil production, and the balance would be sold fresh locally. The passion fruit would be processed into juice and exported to Europe.

The plant would operate on citrus fruit from November through January and on passion fruit from August to October. With the addition of mango and papaya, the plant could operate virtually all year.

European markets for lemons amount to about 300,000 tons annually. It is hoped that Tahitian limes can capture a portion of this market, given the success Brazil is already having with its lime exports.

### Banana Flour

The ITIPAT organization (now Ivorienne de Technologie Tropicale -- I2T) has prepared a study of a project which would use bananas rejected by sorting operations prior to export. The study envisages processing 5,800 tons of banana yearly into:

- . "Maniobanane," a precooked mixture of banana flour and manioc flour suitable for baby food;
- . "Crème de banane" or banana cream, made from banana purée, sugar, and precooked manioc (manioca);
- . "Banana syrup," made from juice pressed from the bananas and filtered with addition of sugar.

All three products are destined for human consumption, the latter two in the confectionery and fruit juice industries. Preparation of an animal feed is also possible using green unripe bananas alone or mixed with other materials.

The factory would be located at Bimbresso, near Abidjan, and would draw on rejected fruit from the collection stations operated by SONACO in the region. It would give value to some of the large tonnages of bananas now totally lost. If CFA 10/kg is paid for the fruit, the price of the final products would be CFA 146/kg of maniobanane, CFA 46/kg for the banana cream, and CFA 66/kg for the syrup. Market

studies are required to determine at what prices these products could be sold in Europe.

### Research

#### Manioc

The I2T research organization has set up an experimental processing plant for manioc at Toumodi. Production tests are being conducted on manioc flour and on two granular prepared forms of manioc, gari and attiéké. The principal product, manioc flour, can be produced at an estimated CFA 100/kg. Because this is considered too high to allow widespread use of the product, efforts are underway to reduce processing costs, mainly by using a "biomass" system to cut fuel costs.

Manioc roots for processing are obtained from a nearby "agro-pastoral" project operated by SODEPALM. Several hundred ha of manioc were planted by participating farmers to allow testing of varieties and of mechanized plantings and harvesting techniques. Results from mechanized operations to date have not been acceptable, and problems continue to be encountered with the equipment.

Production costs for mechanized growing are presently CFA 12.5/kg, but it is hoped that the introduction of improved varieties and cultural practices will lower these costs to a more acceptable level of CFA 10/kg.

An imbalance exists between production and processing as the plant can handle only a fraction of the roots produced. Farmers are thus forced to sell roots in Abidjan, which is not profitable given the costs of transportation.

A profile of this operation appears in Appendix A.

Potatoes and Onions

Research on growing potato and onion crops has been conducted in hopes of substituting local production for the currently large imports of these products. Research on onions has been satisfactory, and the introduction of approved varieties to farmers is planned for 1983. Potatoes are still at the variety testing stage.

## B. NIGERIA

General Observations

The time available did not permit collection of data on fruit and vegetable production, as this involves formal written application to various Federal Ministries. Therefore, emphasis was placed instead on collecting information on fruit and vegetable processing, new project planning, and research activities.

Processing Facilities

Operating fruit and vegetable processing plants in Nigeria are at present limited to one tomato paste/mango juice operation and three fruit juice plants, all in the private sector. Another private sector firm producing tomato sauce is reportedly no longer operating. Several mixed government/private ventures are slated to begin operations during the current 5-year plan period.

Vegetable and Fruit  
Processing Ltd., near  
Gombe (in Borno State)

This company produces tomato paste, tomato juice, and mango juice, all of which is sold within Nigeria under the "VEG-FRU" label. A profile of this company appears in Appendix A.

This past season the company processed 13,000 tons of tomatoes, of which 7,000 tons came from its own adjoining farm, 3,000 tons from local small farmers, and 3,000 tons from a government agricultural development scheme near Kano. Yields on the company farm were 8 to 10 tons/acre, which is

about 10 percent lower than yields obtained in the Ivory Coast on a similar project. The fields are irrigated by water pumped from a nearby river. In contrast, local farmers grow their tomatoes on 1/4 to 1/2 acre plots along river banks without irrigation, and obtain yields of 4 to 5 tons/acre. All farm operations other than plowing and digging of the main irrigation trenches are done manually. Daily wages are N 4 to N 5 (US\$6.20 to US\$7.75 at official rates).

Tomato paste is produced on Italian-made equipment which is reasonably well maintained, but the process includes many batch operations which decrease efficiency. The company plans to add new equipment next season, which will increase capacity and reduce batch operations.

Paste is canned mostly in 70 gm cans made at the site from steel plate imported from Italy already lithographed. In addition to the approximately 2,000 tons of paste produced in the plant, another 2,000 to 2,500 tons of paste are imported from Spain in drums and canned locally. In 1981, canning of tomato juice and mango juice (initially from imported pulp) was begun, but sales have been disappointing.

Cartons of 100 cans of tomato paste wholesale for N 16, or N 0.16 per 70 gm can. They were seen in a Lagos store selling at N 0.25 per can. This is approximately twice the cost of paste made locally in the Ivory Coast at official rates of exchange, or roughly the same cost at unofficial rates. In contrast, imported Italian paste is said to cost about N 5 per carton delivered in Nigeria.

Management estimates the Nigerian market at 2 million cartons (100 cans of 70 gm, equivalent to 14,000 tons) annually, 30 percent of which is supplied from their production, 40 percent from legal imports, and 30 percent from



illegal imports. A 100 percent duty on imported paste plus handling brings retail prices of legally imported paste to roughly the same as the price of the VEG-FRU product. Smuggled paste sells for much less; the company's sales have been affected adversely by smuggled paste and, to a lesser extent, by legal imports.

Kole James and Co., Ibadan

This privately owned firm is producing orange and lemon beverages from Nigerian-grown fruit. Sales in recent years have reportedly been hurt by dominance of the market by Coca Cola and other recognized soft drink bottlers, and by the company's financial and management problems.

Cadbury-Fry, Ikeja (Lagos State)

This company, a UAC subsidiary, formerly produced a spicy tomato sauce (under the brand name "Tomato Pep") at Zaria in Kaduna State. In 1970-71, 1,000 tons of tomatoes were processed, although the plant could handle 3,000 tons. We understand that production closed around 1975 due to difficulties in obtaining sufficient supplies of tomatoes, which had been brought from the Kano area.

New Project Planning

Gongola Tomato Industries,  
Lau (Gongola State)

The 1981-85 5-year plan mentions an integrated tomato project to include a 300 ha estate and processing plant. The plant would process 7,500 tons of fresh tomatoes to

yield 18 million 70-gm cans of tomato paste. We understand that this is a joint government/private venture involving a Swiss firm, which holds a 10 percent interest. At this time only 5 acres of tomatoes are reported to be planted. Tomatoes would also come from the Kano area, and finished paste would be imported. It is reported that paste is already being produced on a small scale in the area.

#### Tomato Project in Plateau State

We understand that a U.S. company has proposed a large-scale tomato growing and processing project in Plateau State, but that action has been temporarily suspended due to economic conditions in Nigeria.

#### Kaduna Vegetable and Fruit Processing, Ltd. Ikara (Kaduna State)

This planned venture would also produce tomato paste. It is said to be a joint venture between the Nigerian Government and a Hungarian organization.

#### Other Projects

The 5-year plan mentions an integrated tomato project in Oyo State ("Oyo North area"); a pineapple production and canning project, also in Oyo State; a tomato processing plant together with a can-making operation in the Hadejia-Jamaari River Basin Development Authority area; and an integrated fruit juice project at an unnamed location.

Also mentioned is a "Smallholders/Nucleus Estate Fruit Trees and Canning Project" involving kola, citrus, cashew, and "bush mango." No details are given.

In view of the current economic situation in Nigeria, especially as regards government budgets, it is expected that some, if not all, of these projects will be delayed.

### Research

#### Plantain Flour

The National Horticultural Research Institute at Ibadan has been conducting research on the manufacture of plantain flour, supported by the Nigerian Government and FAO/UNDP. The Assistant Director of the Institute reports that the research was first done at the University of Birmingham in the United Kingdom, then repeated at Ibadan, and that the work constitutes a "big breakthrough." A flour is produced which can be used in high proportions with wheat flour, constituting what is known as "composite flour" for making bread, biscuits, and cake. The ground plantain fruit is tray-dried at 50°-65°C and then passed through a hammer mill. The flour produced is 25 percent of the weight of the original fruit. It is said to produce an acceptable product even without a mixture of wheat flour.

No further details were available as the process is protected by a patent. The Nigerian sponsors for the research are the institute named above and the Federal Institute of Industrial Research. Plans are for the Nigerian Government to establish the first processing plant, then to license public/private ventures. The institute is also responsible for producing plantain shoots for sale to farmers.

We understand that other countries are participating in this research through the "West African Regional Plantain Research Group," though this may refer only to variety trials.

### Dehydrated Okra

The National Horticultural Research Institute has also conducted research on production of a dehydrated okra powder which could be packaged in paper envelopes for home use in making soups and sauces. The process reportedly retains 98 percent of the mucilage and 90 percent of the chlorophyll and can be stored up to one year. The process involves slicing of the okra, preservation with a mixture of salts (sodium sulfite, carbonate, and chloride), then drying and grinding. When used in cooking, the product is first added to water and, after soaking, the salty solution is decanted off. The process is said to be ready for market testing.

The traditional air drying method is said to cause contamination of the product, breakdown of the mucilage, and oxidation of the chlorophyll which causes a color change.

### Other Products

Other products which the institute believes could be commercialized include two common vegetable seeds which could be dried and cracked, and the nut meat extracted for soup making. The plants are Irvingia gabonensis and the Equisi melon. Seeds of the latter can also be used to make a high-quality edible oil.

## C. SIERRA LEONE

### General Observations

As only one member of the team visited Sierra Leone, survey work was concentrated on processing projects and agricultural research on fruits and vegetables. In addition, considerable time was spent on activities of the Mano River Union (MRU), headquartered in Freetown.

### Processing Facilities

At present, no processing plants for fruits and vegetables are operating in Sierra Leone. A fruit juice plant operated from 1978 to 1980 and then closed down. An analysis of the problems which caused the failure of the project, the Mabole Fruit Company, is given in the following paragraphs.

The Mabole Fruit Company was financed jointly by the National Development Bank of Sierra Leone (NDB) and the Netherlands Finance Company (FMO), an agency of the Dutch Government. It started operation in October 1978, producing a variety of fruit juices and fruit jams. It was based on a 1977 study prepared by the Dutch firm HVA. The company encountered numerous difficulties, however, and ceased operations in October 1980. Efforts are now being made to revive the company, possibly as a licensed Union Industry under MRU regulations.

The failure of this venture, the only fruit or vegetable processing plant in Sierra Leone, merits attention for the lessons it offers for similar ventures which might be planned in the ECOWAS region.

The plant was equipped with a 1 ton/hour processing line involving primarily manual operations for extraction of fruit juices from oranges, grapefruit, guava, pineapple, and mangoes. Jams were prepared in batch kettles using imported sugar. Juices were filled into 200 ml laminated aluminum foil pouches on a Simplex filler, and jam was packed in imported glass jars. Fruit was obtained from farmers in a 40-mile radius of the plant, the price for a ton of oranges being £ 50.<sup>1</sup> Farmers were to benefit from loans from the NDB for purchased inputs. Grapefruit juice sold for £ 0.35 per 200 ml pouch (compared to £ 0.65 for a 177 ml imported can). Orange jam sold for £ 1.1 per 450 gm jar (compared to £ 2.5 per 450 gm jar of imported jam).

The difficulties encountered may be summarized as follows:

- . Farmers delivered oranges of several different varieties, one of which contained excessive amounts of "limonin" which gave the juice a bitter taste. It proved infeasible to separate out these varieties before processing. (This occurred despite the fact that samples of fruit were sent to Holland for testing before the plant was built.) It appears that insufficient attention was paid to an initial survey of production areas or to the planting of appropriate varieties.
- . Deliveries of oranges were irregular and included fruit picked before maturity. Apparently farmers were insufficiently instructed on how and when to pick fruit, and delivery schedules had not been drawn up.
- . A fairly high proportion of the pouches leaked juice due to separation of the lamination after filling. These pouches had to be

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1. At the current official rate of exchange, £ 22 = US\$1.

recycled through the filling line. Although such was not reported, it can be safely assumed that some pouches leaked after delivery to stores or after purchase, causing consumer acceptance problems. It is surmised by those who studied the matter that the problem arose because outdated or rejected pouch material was purchased in an effort to reduce costs.

Following closure of the plant, a Dutch technician reappraised the project in February 1981 and recommended introduction of improved varieties of oranges to farmers (with the aid of government loans), use of a different type of container, re-equipping of the plant at a cost of £ 475,000, and hiring a expatriate management (or establishing a partnership with the local brewery). These recommendations were rejected by the NDB.

Subsequently, in August 1981, a British entrepreneur proposed to take over the facility and expand it to process annually into juice 20,000 tons of passion fruit, 8,000 tons of pineapple, 12,000 bushels of mangoes, and 45,000 bushels of oranges. A total of 750 farm families in the area between Makeni and Kabala were to be organized into cooperatives. Loans for planting plus extension services were to be provided via the IADP project to farm families, who would become shareholders in the enterprise. The heart of the scheme was to be the passion fruit, which reportedly produces 25,000 to 35,000 lbs/acre of fruit annually beginning in the first year after planting of the vines. The prospective investor claimed to have firm orders for 1,000 tons of passion fruit juice per year from a Swiss firm, Passi A.G.

It is reported that some experimental plantings of passion fruit vines were done by farmers under the direction of the investor through the "Koinadugu Experimental Passion

Fruit Project," but no details are available as to results. Unfortunately, after these plantings were made and before any definite steps were taken to establish the enterprise, the potential investor disappeared and has not been heard from since.

In October 1981, the MRU Industrial Development Unit published a study of Union markets and export markets in Europe for various fruit juices, jams, canned fruits, and tomato paste. A two-phase project was recommended starting with juices, jams, soft drinks, and animal feeds (based on fruit wastes), and later adding canned fruit and tomato paste. Approximately 80 percent of the fruit juices and jams were to be exported, with Austrian and Swiss buyers providing "technical and scientific cooperation." In an August 1982 meeting, the MRU Commission on Industry rejected this study because it did not foresee satisfying domestic demand in the member countries before commencing export, and did not take account of the existing fruit juice facilities in Guinea. A new study was requested.

#### The Mano River Union

The Mano River Union, a customs union comprising Sierra Leone, Liberia, and Guinea, has its headquarters in Freetown. It was established in 1973 by Sierra Leone and Liberia, with Guinea joining in 1980. The Union is in the process of implementing agreements calling for the removal of all tariffs between member countries on all goods of local origin. These are defined as goods having not more than 80 percent imported materials as of 1984 (60 percent by 1986), except that (1) local value added as a percent of ex-factory price must be at least 35 percent, and (2) indigenous ownership of the producing enterprise must be at least 20 percent



as of January 1984 (51 percent by 1990). A common external tariff covering 90 percent of all tariff items was adopted by Sierra Leone and Liberia in 1977.

One of the aims of the Union is infrastructure improvement, and studies have been undertaken on a new highway linking Monrovia and Freetown and on a hydroelectric project on the Mano River between Sierra Leone and Liberia.

An Industrial Development Unit was created in the Secretariat in 1980 to identify industrial projects, prepare studies, and assist potential investors in implementing investments. It receives German technical assistance through the consulting firm Atlanta of Hamburg. Among the projects under study are tomato processing and cassava processing. A Union license is granted and investment incentives given (a 6-month embargo on imports of similar goods, exemption from 90 percent of import duties for 10 years on machinery and raw materials, and exemption from excise taxes) for industries for which foreign origin materials do not exceed 60 percent of the total materials used in production, and which have at least 35 percent indigenous participation in the first 2 years and 51 percent by the fifth year.

Thus far, a glass container project in Liberia has been qualified as a Union Industry. It was further decided (in August 1982) that the Mabile Fruit Company of Sierra Leone (see below) should be revived and operated as a Union Industry, and that a study should be undertaken on "the scope for integration, specialization, and cooperation among the fruit juice, jam and packaging industries in the member states." The latter provision takes into account existing fruit juice plants in Guinea whose products have been qualified as goods of local origin.

### New Project Planning

As noted above, efforts are being made to revive the Mabile Fruit Company. Several proposals have been made in this regard, but we understand that no action is being taken on them.

The Industrial Development Unit of the Mano River Union plans to undertake prefeasibility studies on tomato paste and fruit juice processing in early 1983. A British food technologist is scheduled to spend 3 months in Sierra Leone under the auspices of the FAO to carry out the work. It is expected that this work will have a bearing on planning for the Mabile plant.

### Research

The USAID-supported ACRE project (Adaptive Crop Research and Extension) at Njala was visited in the course of the Sierra Leone country survey.

Project staff work with selected progressive farmers in five agro-economic zones in Sierra Leone. The focus is on food crops: cereals, root crops, legumes, and vegetables. The project includes research on improved varieties, improved storage techniques, cultural practices, seed multiplication, and nutrition. Onion drying is a priority for the project.

Although it is not strictly a processing activity, onion drying and storage will be touched on here because of the importance of onions as an import substitution crop in the country. Imports in Sierra Leone for 1981 are estimated at 11,000 tons, worth US\$8 million. Consumption, including local production and unrecorded imports, is estimated at 16,000 tons or about 11 lbs per capita.

A recent FAO report states that new onion cultivars have been developed which bulb satisfactorily under short photo-periods prevailing in the tropics. They will, however, not flower, and seed must consequently be imported. It is recommended that, after digging, the onions be left to cure for 2 days on the ground and then packed in mesh bags or wooden crates. Storage should be on shelves in specially constructed sheds designed in Sénégal. The variety "Violet de Galmi" is said to have the best keeping qualities; losses of less than 10 percent after 3 to 6 months of storage are reported.

Studies on onion storage are to be undertaken also by the ACRE project in Sierra Leone.

## D. MAURITANIA

General Observations

The Islamic Republic of Mauritania at present has a population of nearly 1.5 million, most of whom live along the coast and in the Sénégal River Valley.

The country may be divided into four natural zones on the basis of the annual amount of rainfall:

- . The Sahara zone in the north, a desert area which covers two-thirds of the land area, and receives between 0 and 150 mm of rain a year;
- . The Sahelian zone, south of the Sahara region, which has an annual rainfall between 150 and 450 mm;
- . The Sénégal River Valley (the Chemama), which receives relatively more rain -- between 350 and 650 mm a year;
- . The coastal zone, which is 650 km long and receives 25 mm of rain a year along the coast, and 100 to 150 mm a year between Nouakchott and the extreme south of the country.

As can be inferred from the amounts of rainfall noted above, the Sénégal River Valley is the main agricultural region in the country. It accounts for nearly 70 percent of the country's total agricultural production.

Although handicapped by its sandy soils and arid climate, Mauritanian agriculture has in recent years developed very rapidly in the produce sector. However, the production of such traditional crops as dates has remained stagnant.

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### Production

Fruits and vegetables are grown primarily in the Sénégal River region and oases. The cultivation of vegetables -- such as tomatoes, potatoes, cabbages, onions, carrots, sweet potatoes, lettuce, radish, and turnips -- was introduced at a fairly recent date. Watermelons are also produced in sizable quantities. Fruit crops -- dates, sweet bananas, and some citrus -- have traditionally been grown in oases and the Sénégal River region.

The yields obtained are low and hardly encouraging. This is attributable to the country's particularly harsh natural conditions -- insufficient rain and the absence of rivers; strong winds; high temperatures; and poor soils.

The national production is supplemented by imports of fresh produce from Sénégal and canned food from Europe and elsewhere (tomato concentrate, pineapple juice, jams).

### Vegetable Crop Production

Reliable data on the production of vegetables were not available. (FAO data indicate that 2,300 tons of vegetables and 4,300 tons of melons were produced in 1979.) Intervention by the government is restricted basically to supplying seeds (which are distributed free to growers), supplying agricultural equipment at subsidized prices, and training and assisting private growers.

Vegetable production is the result of efforts of farmers usually associated in cooperatives. Four agricultural systems, determined by soil and climate conditions, are practiced:

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- . Rainfed agriculture: Melon and cowpeas are grown as rainfed crops in the Sénégal River region and Sahelian zone. These crops are supplemented by millet and sorghum (guinea corn). These are short-season varieties grown from July to October.
- . Floodland agriculture: Floodland agriculture is practiced in the Sénégal River Valley and in riverbeds (wadis) after the floods have receded. Crop irrigation is supplemented by sprinkling of water drawn from shallow wells dug in the riverbed. The crops grown are tomatoes, onions, sweet potatoes, potatoes, okra (gombo), cabbage, squash (gourd), maize (corn), melon, and cowpeas.
- . Oasis agriculture: Crops are grown in date palm groves, under the trees which protect them from winds and excessive heat. These crops are sprinkler irrigated. They are grown from March through May (tomatoes).
- . Garden or farm agriculture: There are three types of garden or farm agriculture:
  - . Cooperative gardens, 1 to 3 ha in area, maintained by family labor;
  - . Large-scale farms, from 2 to 20 ha, irrigated by pumping; crops are grown for markets in the large cities (Nouakchott and Kaedi);
  - . Private small-scale farms, irrigated by sprinkling; these are usually family plots in the Sénégal River region, and production is for the most part consumed on the farm.

With regard to vegetable production in Mauritania, it is important to mention the Nouakchott Vegetable Farm. This farm extends over an area of about 20 ha. It was established as an agricultural experiment station to test new varieties and their behavior in the field. However, the research work was discontinued for lack of financing. Since 1981, only a few trials with onions -- oignon violet and oignon blanc de

Galmi -- have been conducted, as highly encouraging results were obtained with these varieties at Kaedi (yields of 35 to 40 tons/ha).

The area used for commercial production proper is about 19 ha. The private growers are joined together in two cooperatives; one was established by the growers themselves, and the other was established, supervised, and subsidized by Croissant Rouge.

Crops grown: Tomatoes, carrots, turnips, mint, leeks, pimento, eggplants, lettuce, cabbages.

Irrigation water: Water used for irrigating the crops is provided by the municipal wastewater treatment plant. Although the quality of this treated water is well below sanitary standards, necessity dictates its use. Due to the lack of a meter, no data are available on actual water needs per cultivated ha or on the cost of such water. Therefore, each grower pays a flat rate of 600 ougias per month.

Farming arrangements: Most growers cultivate their own individual plots. However, a number of plots are leased out to farmers. In this case, the farmer is a salaried employee (being paid 1,500 UM/month) or he receives half of the monthly profits from his plot. In such cases the agricultural worker may receive his daily meals from the landlord. The landlord withholds an allowance for his meals from his vegetable production to the extent of 50 UM per day. The net monthly profit from a plot of 0.25 ha is about 10,000 UM per month.

Farming methods: Crops are grown on small plots, using light tools (daba hoe, spade, etc.). The plots are thoroughly

watered to offset evaporation and prevent raising of the mineralized water table. Pesticides and fungicides are periodically applied to the plants. The farmers import their seeds, chemicals, and sprinkling equipment, or purchase them directly from traders.

Marketing of crops: The cooperatives played an effective service role during the period of settlement by the farmers. However, at present each grower is practically independent. Cooperatives now perform a representative role; they have no significant impact on the production and marketing of crops. Production costs are difficult to measure.

Sale prices vary, and are mostly influenced by imports of vegetables from Sénégal: 90 UM/kg for tomatoes and 35 to 50 UM/kg for other produce.

### Fruit Production

Fruit production is very low in Mauritania. It is limited to the Sénégal River region where sweet bananas and a few citrus fruits are produced. In the country as a whole, only dates are grown in all eco-climatic zones. FAO data indicate that 2,000 tons of fruit were produced in 1979 (excluding dates).

About 1 million date palm trees are to be found in Mauritania, distributed as follows:

- . Adrar: 450,000 plants;
- . Tagant: 275,000 plants;
- . Assaba: 175,000 plants;
- . Hodh and remainder of country: 100,000 plants.



Annual production is estimated at 14,000 tons, consumed fresh (30 percent) and in the form of dried dates (70 percent). Dates are produced at the cottage level, although there is a processing plant at Atar for eliminating insects from the fruit.

#### Processing Facilities

Processing is practically nonexistent in Mauritania, except for the date processing plant at Atar.

Canned food is imported from other African or European countries. The largest import item is tomato paste, of which an estimated 3,000 tons was imported in 1980.

#### New Project Planning

Along with a policy of encouragement and technical assistance at the national level, projects are under study for establishing companies capable of speeding up the development of production. Thus, the following will soon be created:

- . The Société d'approvisionnement du monde rural (Rural Supply Company) will be assigned the function of marketing inputs and agricultural equipment. This project is under study by the Research and Development Office (Bureau d'Etude) of the Fonds National de Développement (National Development Fund).
- . A cold storage plant will be established for packing fresh produce and processed foodstuffs.
- . A Société de commercialisation des fruits et légumes (Fruit and Vegetable Marketing Company) is also under study.

The Manantali Dam, under construction on the Sénégal River, will improve the quality of available water and soils

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by preventing salinization and the admission of tidal salt-water during the dry seasons. It will also enable cultivated areas to be extended by increasing the amount of water available to farmers.

## E. BENIN

General ObservationsIntroduction

The Republic of Benin, with an area of 112,000 sq km, today has nearly 36 inhabitants per sq km, or a population estimated to be 4 million.

It is in the humid equatorial zone, and most of the fruits and vegetables grown and consumed in the Ivory Coast are also to be found in Benin. Benin also grows traditional leafy vegetables, which are generally consumed in sauces. These crops are now grown virtually everywhere in the country and represent 70 percent of total vegetable consumption. This situation is the result of the activities of the Center for Garden Cultivation and Nutritional Activities (Centre des Activités Horticoles et Nutritionnelles) in Porto Novo, which has studied and shown the nutritive value of these vegetables: voandzou (bambara groundnut), vernonia telfaira, trichosanthes, etc.

Mode of Consumption

Fruits and vegetables produced are consumed fresh (citrus and other fruits), cooked as sauces (leafy vegetables), or canned (tomato juice and concentrate, orange juice).

There are, however, artisan processing units such as ones for use of cashew apple in preparation of juice and medicinal syrup, as well as use of mango, papaya, and guava

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for preparing juice, jellies, and preserves. Cashew nuts are also roasted in artisan units.

Industrial processing units essentially manufacture the following products: tomato concentrate, mango juice and nectar, essential oils, and citrus fruit juice.

Starchy foods -- cassava (manioc), plantain, and yams (igname) -- are consumed as they are in the Ivory Coast.

### Production

#### Organization of Production

In Benin, fruit and vegetable production is the responsibility of SONAFEL, a public corporation established in 1975 for the following purposes:

- . Promotion of production, preservation, processing, and marketing of fruits and vegetables;
- . Technical assistance to rural development centers (CARDERS) as regards fruits and vegetables; and
- . Management of the production and processing of cashew.

SONAFEL's production activities are organized within two areas: (1) nurseries for the production of fruit trees, for both its own projects and private plantations; and (2) agro-industrial projects responsible for producing and processing a specific crop. Within the area of these projects, work is performed by SONAFEL's own salaried staff. The nurseries' production is used to supply the industrial unit,

which also receives produce supplied by private planters established around the plant. Agro-industrial complexes have been established at:

- . Natitingou (Atakora Province) for tomato and mangoes;
- . Allahé (Zou Province) for citrus fruits; and
- . Parakou (Borgou Province) for cashew.

SONAFEL currently has available to it an area of 150 ha of fruit-bearing citrus trees; to this will be added 200 ha which will start producing in 1983.

As regards vegetable crops, their development is the responsibility of the Center for Garden Cultivation and Nutritional Activities in Porto Novo. The Center has the following functions:

- . Assistance to and supervision of vegetable growers;
- . Supplying of technical materials (seeds, fertilizers, pesticides); and
- . Training of planters.

The Center also owns demonstration and experimental plots (10 to 15 ares).

The Center has carried out extensive research work on the nutritive value of a wide range of local vegetables which were selected for family-scale production. The Center also assists and supervises farmers who grow temperate-climate vegetables: cabbage, lettuce, sugarbeet, snap beans, soybeans, sesame, etc.

Production areas for widely consumed starchy crops are as follows:

- . Yams: Produced in the north and center regions of Benin, eaten as foutou and dried slices (cossettes);
- . Cassava (manioc): Produced all over the country, eaten as flour as well as dried and grated meal (gari); and
- . Plantain: Produced in the south, sold fresh and exported to Niger and Nigeria.

Production and Consumption  
Data for 1970, 1975, and 1980

No precise statistical documents are available in Benin regarding fruit and vegetable production and consumption. Therefore, the data in Exhibits II-2 and II-3, as well as the general summary of needs that follows, were derived from data collected in the final report of a study of vegetable production development in the Entente countries prepared in 1973 by the Bureau pour le Développement de la Production Agricole (BDPA).

Exhibit II-2. Vegetable Consumption  
in Benin

Year	Total population	Annual vegetable consumption per capita	Total consumption (tons)
1970	2,600,000	21.0	55,000
1975	2,970,000	21.6	64,000
1980	3,390,000	22.1	75,000

Exhibit II-3. Vegetable Production, On-Farm  
Consumption, and Marketing Estimates in Benin, 1980

Vegetables	Production		Marketed		On-farm consumption	
	Tons	Percent	Tons	Percent	Tons	Percent
Leafy vegetables	46,500	100	41,850	90	4,650	10
Tomatoes	43,000 <sup>a</sup>	100	25,800	60	10,300	40
Onions	5,060	100	3,040	60	2,024	40
Pimento	116	100	104	90	12	10
Okra	551	100	496	90	55	10
Potatoes	400	100	120	30	280	70
Beans <sup>a</sup>	37,000	100	18,500	50	18,500	50

a. Actual production figures are higher than the above estimates, due to the establishment of new agro-industrial projects.

Foreign Trade -  
Imports and Exports

Onions and potatoes represent the greater part of vegetable imports. The volume of these imports has reached nearly 800-900 tons/year. The main export crop is pimento: 250 tons/year are currently exported.

General Summary of Needs

Out of a total need of 75,000 tons, 74,000 tons of vegetables are consumed on the farm or marketed within the country. It appears that only 1,000 tons of onions and

potatoes are imported. It should be noted that plantain and yams are exported to Nigeria and Niger, although the market is difficult to control and cannot be quantitatively estimated.

### Processing Facilities

The state agency SONAFEL is responsible for the creation of agro-industrial complexes in Benin. These number three at present:

- . A tomato paste/mango nectar plant now in operation;
- . A citrus juice/citrus oil plant which has technical problems and has never operated; and
- . Cashew processing.

### Tomato Paste/Mango Nectar

The existing tomato paste/mango nectar plant was built in 1979 at Natitingou, in the north some 650 km from Cotonou. It can process 4 tons/hour of tomatoes, which would give it a seasonal capacity of about 8,500 tons, assuming a three-shift operation for 90 days. However, in the 1981-82 season, only 380 tons of tomatoes were processed. Numerous problems are being experienced, among which are the following:

- . Late delivery of cans from the manufacturer in Abidjan, caused mainly by payment problems occasioned by Benin Government accounting procedures (the manufacturer requires orders to be placed 6 months ahead);
- . Lack of funds to purchase needed spare parts;



- . Equipment problems with the paste filler, causing losses of product; and
- . Delivery of unripe (yellow) fruit, causing an undesirable color in the paste.

All machinery is Italian, mainly from Bertuzzi. A specialist from Bertuzzi is assisting with the equipment problems.

SONAFEL is also responsible for the production of tomatoes in the area of the plant, assisted by Italian specialists. Yields of 15 tons/ha were obtained in the 1981-82 season, compared to 12 tons/ha the previous year. (In contrast, yields of 25 tons/ha are being obtained in the Ivory Coast and Nigeria.) A total of 76 ha were planted, producing 1,120 tons of tomatoes. The excess over what the plant processed, and spoilage, was sold in Cotonou and in Togo.

SONAFEL management states that their product is not yet competitive, and that once the plant is in full production with a quality product they will need protection against imported paste if the enterprise is to be profitable. Promotion and advertising will be necessary to persuade people that the product is equal to imported paste. Maximum production of 1,400 tons of paste would approximately satisfy local demand.

Mango nectar production is quite small at present. Mangoes are bought from local farmers, 50 tons of them this year. Interest is reported among European importers, but the packaging needs improvement.

Cans are obtained from Italy at a delivered price in Cotonou of CFA 32 per 140 gm capacity can. At present labels are applied locally, but it is planned to go to lithographed cans next year.

Production cost data are not available as an accounting system is not yet in place.

### Citrus Juice and Oil

Located at Halatia, in the center of the country, the citrus juice/citrus oil plant was built in 1978 but has never operated. It is intended to produce citrus juice and citrus oils from locally grown lemons, oranges, grapefruit, mandarins, and pomelo. Oils would be exported in 200 liter drums, while juice would be delivered in drums to the local brewery for bottling of soft drinks.

SONAFEL has 150 ha of citrus trees now in production, with another 200 ha soon to be in production. Root stock for grafting was obtained from California.

Equipment problems continue to be experienced at the plant. French technicians are at the site now attempting to get the plant into production.

### Cashew

Little is known about the cashew processing plant, except that it is located at Parakou and that cashew nuts are being processed. Cashew fruit is consumed locally as juice or made into alcohol, but no fruit is processed industrially at present.

Note: SONAFEL states that government policy encourages foreign participation in food processing ventures, either as mixed government/private companies or even as entirely private ventures.

#### New Project Planning

In view of the difficulty being experienced with existing plants, no new projects are planned for the next 5 years.

Possible future processing projects mentioned by SONAFEL include:

- . Pickles;
- . Canned green beans;
- . Potato flakes;
- . Yam (igname) flakes; and
- . Dehydrated onions.

#### Research

Research or studies are being conducted on the following:

- . Production of gari from manioc;
- . Igname chips or flakes; and
- . Potato growing (with French aid).

The Center for Garden Cultivation and Nutritional Activities at Porto Novo has developed a nutritious flour for babies using local and imported materials, including local rice, corn, millet, sorghum, peanuts, and beans, and imported soya (P.L. 480 through Catholic Relief).

## F. SENEGAL

General Observations

The Republic of Sénégal has an area of 196,000 sq km, with a population in 1981 of about 5.6 million people.

It is a Sahelian country, with little rainfall, and is characterized by a long dry season and a fairly short rainy season extending from June to August. It is drained in the north by the Sénégal River and in the south by the Gambia River.

On the whole, its soils are sandy, poor, and not favorable for rainfed agriculture, except for the Sénégal River and Casamance regions. However, vegetables are widely cultivated, with more or less extensive irrigation and with varying degrees of success.

Potentially, the Sénégal River and Casamance regions are the most suitable for fruit and vegetable production, but these crops are now better established in regions where they can more readily be sold and marketed. The areas of production are the Cap Vert region (58 percent), Thiès region (22 percent), and Sénégal River region (9 percent). A range of African vegetables is grown:

- . Okra;
- . Eggplants;
- . Pumpkins;
- . Pimento; and
- . Diakhatou.

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In addition, European or so-called "import" vegetables are raised, including:

- . Tomatoes;
- . Green beans;
- . Carrots;
- . Melons;
- . Radishes;
- . Onions;
- . Cabbages (round green, smooth-leafed)
- . Leeks;
- . Cucumbers;
- . Cauliflower;
- . Squash;
- . Parsley; and
- . Sorrel.

Except for tomatoes, which are processed into a concentrate in the processing plants of the Société Nationale de Tomato Industrielle (SNTI) and the Société de Conserve Alimentaire du Sénégal (SOCAS), all vegetables grown in Sénégal are consumed or exported in the fresh state.

Because of unfavorable eco-climatic conditions, fruit production remains marginal. In the Casamance and Sénégal River regions, citrus fruits, mangoes, cashews, and bananas are grown, although the level of production is far from meeting domestic needs. There are no fruit processing facilities: the entire production is consumed fresh.

### Production

#### Vegetable Production

After peanuts and rice, vegetable production remains one of the most important agricultural activities in Sénégal. Vegetables are grown in the countryside, as well as in a "green belt" around the major cities.

Two types of farming may be distinguished on the basis of the production systems and size of the farms: the traditional sector and the modern sector.

#### Traditional Sector

The traditional sector includes all small vegetable growers who raise vegetables on family farms (0.20 ha, on the average) and use unsophisticated traditional methods: simple implements; watering by hand, on a more or less regular schedule, with water drawn from wells; cultivation of hardy common varieties ("bon jardinier" for lettuce, "jaune hatif de Valence" for onion, "casaque rouge" for tomato). These vegetable growers produce their own seeds and use very little manure or pesticides.

Under these conditions, yields are low (3 tons/ha). However, given the number of family farms, production by the traditional sector is higher than that of the modern sector, accounting for more than 70 percent of national vegetable production.

In the light of the figures listed in Exhibit II-4, it is clear that the production of vegetables has remained virtually static since 1976/77.

Exhibit II-4. Vegetable Production  
in Senegal, 1976/77 through 1981/82

Year	Ha	Tons	Tons/ha
1976/77	6,609	103,839	15.64
1977/78	6,943	102,454	14.73
1978/79	6,308	85,360	13.53
1979/80	5,875	81,466	13.87
1980/81	5,800	80,670	13.72
1981/82	6,976	103,240	14.80

Source: Fifth and Sixth Five-Year Plans from the Ministry of Rural Development.

Modern Sector

The modern sector includes government-sponsored vegetable farms and agro-industrial complexes.

Government-sponsored farms. These are areas developed and equipped through domestic, foreign, or combined financing for the purpose of increasing vegetable production. The farms are usually developed along major roads to facilitate the transportation of crops to the local markets: Baobab, Tivaouane-Peulh, Kirene, M'Bour. They range in size from 100 to 150 ha, and 150 to 200 vegetable growers are settled on each farm.

Cultivation practices are more sophisticated: raising of new high-yield varieties, use of improved seeds, irrigation by open ditches or overhead sprinkling, use of fertilizers and pesticides.

Crops generally grown include Charentais melons, watermelons, potatoes, onions, and green cabbages. Yields range from 8 to 10 tons/ha, and the bulk of production is marketed.

Basic investments for these farms are provided by the Sénégalaise Government out of its own funds or with foreign financing (UNDP/FAO, CARITAS, USAID); however, because these farms are broken up into small family plots, it is virtually impossible to determine the actual production cost, as is also the case with traditional farms. However, a recent study conducted by the Centre pour le Développement de l'Horticulture has determined the unit production cost for major vegetables:

	<u>CFA/kg</u>
Potatoes	31
Onions	22
Food tomatoes	13.5
Round-head cabbage	17
Eggplants	26
Green beans	45

These prices were computed with reference to a modern farm in 1980.

Agro-industrial units. The agro-industrial complexes employ salaried government workers and raise produce which is both marketed fresh (BUD-Senegal SAF) and industrially processed (SOCAS and SNTI for tomatoes). The same applies to the SAED vegetable farm at Dagana, whose tomato production supplies the SNTI plant. These complexes raise other vegetables in rotation with the main crop. For example, the main purpose of the SOCAS complex developed at Savoigne is the raising and processing of industrial tomatoes, but it also grows potatoes and onions for the fresh produce market.

Exhibit II-5 gives data on tomato production for the area cultivated under SAED's sponsorship. The decrease in production during 1978/79 is probably due to the drought and subsequent salinization of the Sénégal River.

#### Government Agencies Involved in Vegetable Production

The role of the government remains important in vegetable production as regards both the establishment of basic infrastructure and the organization of production, including financing, technical supervision of vegetable growers, and supply of agricultural inputs. Thus, the government intervenes in both the traditional and the modern sectors, particularly at the level of state-sponsored farms and in the Sénégal River region through SAED.



Exhibit II-5. SAED Tomato Production, 1969-79

Year	Total cultivated area (ha)	Average yield (tons/ha)	Estimated production (tons)	Processed at plant (tons)	Yield for processed product (tons/ha)
1969/70	6	30	180	-	-
1970/71	13	30	390	-	-
1971/72	30	30	900	-	-
1972/73	77	20	1,500	1,125	14.6
1973/74	144	18	2,650	1,150	8.0
1974/75	650	14	8,900	4,970	7.7
1975/76	1,080	12	12,700	7,830	7.3
1976/77	880	20	17,600	10,220	11.6
1977/78	800	19	15,600	10,365	13.0
1978/79	805	12.1	9,750	7,339	9.2
1979/80	1,000 (goal)		20,000 (goal)		
	787 (actual)				

Source: SAED.

Private organizations have had a diminished impact on production since BUD-Senegal was liquidated in 1979. SOCAS and SAF remain the only two private enterprises concerned chiefly with vegetable production.

#### Fruit Production

Fruits consumed in Sénégal are for the most part imported: oranges from Morocco and Spain; bananas, avocados, and pineapple from the Ivory Coast; mangoes from Guinea and Mali.

However, some limited fruit crops are grown around farm dwellings and in small orchards. Modern farms are rare, except for the 83 ha banana grove developed in the Casamance region from 1968 to 1973 by DGPA with the help of IFAC. Other fruits (pineapples, avocados, papayas) are grown in a very limited number of locations and in very small plantings. It is virtually impossible to determine the quantities produced.

The negligible level of fruit production is due to natural conditions unfavorable to its development; these conditions have been aggravated in recent years by droughts. Exhibit II-6 indicates the estimated level of fruit production in 1979/80.

The difficulties of this sector also derive from the high level of investment that is necessary (more than CFA 1 million/ha); the lengthy period before the fruit trees become productive (4 to 5 years), which ties up capital; and the use of highly specialized methods for which most planters are not prepared.

A large-scale activity in this field can be undertaken only by the state, and its success will hinge upon the availability of a cadre of qualified extension agents.

Exhibit II-6. Estimated Fruit Production, 1979/80

Crops	Area (ha)	Production (tons)
Citrus fruits	1,500	16,000
Mangoes	2,500	25,000
Pineapple	10	150
Avocados	15	50
Bananas	83	2,000
Others	260	2,600
TOTAL	4,368	45,800

### Development Potential

The potential for fruit and vegetable production is far from being fully developed. As regards land use, only in the Cap Vert region are farms threatened by urban development; in other regions, the availability of land is not a problem.

In the traditional sector, vegetable production could be increased by the intervention of a small number of trained extension personnel, who could introduce more productive new varieties and encourage the use of manure, pesticides, and improved seeds.

Human resources are not lacking. However, vegetable raising is cultivation of the intensive type, which requires a specialized and experienced labor force (five permanent workers/ha) rather than merely a large number of workers.

As regards fruit cultivation, there are favorable natural conditions in two areas: the Sénégal River and Casamance regions. In the Sénégal River region, the problem of water availability will be solved by 1986, when the Manantali Dam will be completed and the flow of the river regulated; upstream, the Diama Dam will make it possible to increase water reserves and prevent the rise of tidal salt-water during the dry season. The Sénégal River region would then be suitable for citrus fruit and mango cultivation.

In the Casamance region, natural conditions are suitable for the cultivation of bananas, pineapple, and avocados. The only constraint to the development of these crops is the lack of necessary capital which, given the time it takes for these plants to mature, would not be immediately recoverable.

### Agricultural Research

Agricultural research is being carried out in Sénégal by the Institut Sénégalais de Recherche Agronomique and the Centre de Développement de l'Horticulture. The Centre de Développement de l'Horticulture (CDH) is located at Camberene (Dakar) and receives the support of the Sénégalaise Government, as well as financial aid from bilateral (Belgium) and multi-national (FAO) sources. Several trials have been successfully conducted to develop new varieties of vegetables which are better suited to the country's natural conditions and are more productive. In addition, the Center is involved in the production of improved seeds which are supplied to vegetable growers either directly or through extension agencies. The results obtained by CDH are encouraging.

The Institut Sénégalais de Recherche Agronomique (ISRA) has its headquarters in Dakar and a main station at Bambey. Although it is concerned with agricultural research in general, it also focuses on particular aspects of vegetable cultivation, primarily of industrial tomatoes. In this regard, it has been assessing the efficient use of water resources, the maintenance of fertility in previously flooded lands, agricultural systems, and the application of research.

### Processing Facilities

The only fruit or vegetable being processed in quantity at present is the tomato. Tomato paste is produced at two locations. A small citrus fruit juice plant is reported to be operating in the Casamance region, but no production figures were available.

Société Nationale de  
Tomate Industrielle

The Société Nationale de Tomate Industrielle (SNTI), a state enterprise at Dagana on the Sénégal River, processes tomatoes grown by a farmer cooperative on nearby irrigated lands. The 2,000 ha area is planted mainly in tomatoes (600 ha) and rice, plus small areas of vegetables. Extension services, tractor and rice harvester operations, and credit facilities are available through SAED, a state development agency. The well-equipped processing plant could process 12,000 tons if it operated three shifts/day for 80 days. However, it processed less than half that amount last year, producing 700 to 800 tons of paste.

The reasons for this have to do with the low price for tomatoes paid by the plant compared to the fresh market price (CFA 25/kg, compared with CFA 80-100/kg early in the season). SAED has put into place a cooperative structure which organizes farmers by families on individual parcels of land. Because of a lack of central control, the farmers do not respect planting schedules and have been selling at least one-quarter of their production on the open market. Failure to observe planting schedules produces a period of glut which the factory has difficulty in handling (in part due to a shortage of field boxes).

An additional problem is the salinization of the Sénégal River, which reduces tomato yields when it occurs in the spring each year. As previously noted, salt barrier dam now under construction should permit sizable production increases by 1989.

Tomato paste is sold ex-factory at CFA 500/kg, which makes SNTI a high-cost producer. This is roughly three times the cost of imported paste, and 25 percent higher than paste produced in the Ivory Coast.

A full description of this operation is included in Appendix A as Profile No. 7.

Société de Conserve Alimentaire  
du Sénégal

The Société de Conserve Alimentaire du Sénégal (SOCAS) is a private venture located at Savoigne (near St. Louis). It operates a 120 km irrigated tomato plantation, and also buys tomatoes from local farmers. (It has also purchased at Dagana, taking advantage of SNTI's problems with collection.) SAED has assisted local farmers under their "Operation Tomato." The plant, which we did not visit, is reported to have a capacity of 400 tons/day (three shifts).

SOCAS was reported to be in financial difficulty, as it has been operating below the breakeven point. In 1978-79 it processed only 5,000 tons, compared with 15,000 tons in 1977-78. No recent information was available. It is understood that SOCAS is surviving by such means as bringing tomatoes all the way from Dagana.

New Project Planning

A project to produce fruit juice at Ziguinchor in the Casamance region has been under discussion since 1975. Changes were made in the project recently when production of fruits such as oranges, papaya, grapefruit, and guava in the area proved to be too dispersed. Only lemons and mango were available in sufficient quantities for industrial processing, it was found.

It has been decided to establish a 100 ha plantation and to delay construction of a processing plant for 3 to 5 years, i.e., until the trees begin to bear. In the meantime, the promoters of the project plan to build a facility at Thiès, near Dakar, to package fruit juices based on imported juice concentrates. A plantation will also be established at this location. The packaging plant will eventually be supplied with concentrate by the Ziguinchor processing plant. All products are to be sold in Sénégal.

Sénégalaise shareholders in the enterprise will include growers' cooperatives, several state enterprises, the commune of Ziguinchor, and a Sénégalaise businessman/promoter. Foreign shareholders include a French firm, Joker S.A. (which will provide technical assistance), Proparco (a subsidiary of the Caisse Central of Paris), and the Centre pour le Développement Industriel (CDI) of Brussels. Loans are being sought from the West African Development Bank and commercial banks.

The most recent feasibility study on this project unfortunately could not be located for us by SONEDI, one of the promoters. It is therefore difficult to render a judgment on the project as it now stands, especially with regard to the product mix. Earlier studies proposed processing a wide range of juices, as well as jams and jellies, which might have resulted in a costly plant unsuited to take advantage of economies of scale. It is also unclear if export to Europe of the more exotic juices is planned, which seems logical with the help of European partners.

Another document we examined projected initial production of the plant at 600 tons of fruit juices and 130 tons of jam, based on estimated markets in Sénégal of 1,200 tons

of juice and 180 tons of jam annually. Total investment in this plant was projected at CFA 550 million, of which 63 percent would be financed by loans.

### Research on Processing

Some interesting work is being done in Sénégal on simple, inexpensive solar dryers or dehydrators which can be built by villagers for under CFA 5,000 (US\$150). Tests have shown that these units have a potential for preserving produce which would otherwise spoil in periods of glut, such as tomatoes, onions, pimento, sweet peppers, okra, eggplant, cabbage, green beans, mangoes, bananas, sweet potatoes, potatoes, papaya, and garlic.

One model tested in the lower Casamance region has walls of clay and a clear polyethylene window in a wooden frame positioned on top at an angle toward the sun. The fruit or vegetables are laid out on a netting surface inside. Small openings at the front or rear allow air to pass through heat. With proper adjustment of air flow to match local conditions, a temperature of 55°C and relative humidity of 40 percent is attained. From 8 to 10 kg of produce can be dried in 1 to 3 days, depending on the type of produce, in the 3.6 m long X 1.1 m wide dryer.

Compared to traditional drying methods, the solar dehydrators allow produce to dry faster and thus with less spoilage; they are more sanitary, because insects and dust cannot reach the produce; there is less loss to animals; and as the produce is more thoroughly dried, it stores better. For these reasons, the solar dehydrators have a greater potential than traditional methods for preserving food and increasing food supplies in rural areas.



Further tests are being conducted to determine if villagers will build and utilize these devices without outside assistance, and to what extent the dried product is acceptable in the market. Although the dried product could be used by the dehydrator owners in their own homes, the main incentive for its use is the off-season sales it will generate for the women involved (typically groups of five women).

Another problem being investigated is the storability of the dried product. Properly stored in hermetically sealed containers, it should keep for as long as a year. Tests will be conducted with readily available containers to devise a suitable method for long-term storage.

Acceptability has been good, as far as taste and appearance of the rehydrated product are concerned.

The tests are being conducted under the auspices of SOMIVAC (the development agency for the Casamance region) by Mrs. Janis Timberlake under a USAID contract. The Institut de Technologie Alimentaire in Dakar has provided support for the project.

## G. GUINEA

General Observations

The People's Republic of Guinea extends over an area of 246,000 sq km and has a population of 6.4 million people, 70 percent of whom live and work in rural areas. It has a humid tropical climate, with an average rainfall of 2,000 mm/year. It is covered with a very dense drainage network, with numerous perennial rivers.

There are four well-differentiated eco-climatic regions:

- . Lower Guinea includes the coastal plain, which is hot and humid and partially covered with mangrove swamps. This region is well suited for the growing of cereals, fruit trees, and vegetables. It is also suitable for livestock raising.
- . The highlands are situated between 600 and 1,500 m above sea level. The climate there is milder than in lower Guinea. This region is suitable for livestock raising and the growing of cereal crops.
- . Upper Guinea has high temperatures and a dry season that is longer than that in any other part of the country. It forms a part of the upper Niger plains and is suitable for the growing of cereal crops.
- . The forest region, in the southwest corner of the country, is a mountainous region covered with dense tropical forest. It is suitable for the cultivation of trees and a wide range of food crops: yams, plantain, cocoyams, okra, eggplant, and pimento.

The geoclimatic conditions are favorable for both rain-fed and irrigated crops. Water resources are abundant: the rivers are perennial and the high level of rainfall permits the constitution of water reserves through building of dams. Indeed, Guinea abounds in sites suitable for dams.

Guinea has extensive forest areas (170,000 sq km) which are still undeveloped, as well as large tropical vegetation areas (woodland and savanna woodland). All are rich in potential.

Guinea has the labor needed to develop these lands. Most of the population is young, constituting a labor reserve that is relatively less expensive than those in neighboring countries.

### Production

#### Types of Crops

Owing to the diverse eco-climatic conditions in its various regions, the country is well suited for the growing of a wide range of tropical agricultural crops. Thus, the following crops are to be found in Guinea, at various stages of development:

- . Industrial crops: coffee, oil palms, cotton, cocoa;
- . Cereals and roots: corn, rice, sorghum, yams, cassava, cocoyams, sweet potatoes;
- . Traditional tropical vegetables: okra, pimento, cowpeas, eggplants;
- . So-called imported vegetables: tomatoes, cabbages, green beans, lettuce, cucumbers, watermelons, potatoes; and

- . Fruits: bananas, mangoes, citrus fruits, papaya.

The fruit and vegetable crops grown in Guinea are generally consumed fresh; however, part of the production of citrus fruits, mangoes, and tomatoes is processed into juice or nectar (citrus fruits and mangoes) and concentrate (tomatoes).

### Organization of Production

Agricultural production -- and specifically fruit and vegetable production -- is engaged in by local farmers, joint private/government projects, and government projects. Agricultural activities are promoted by three ministries: the Ministry of Agriculture, the Ministry of FAPAs (Fermes Agro-Pastorales d'Arrondissement) and Agricultural Cooperatives, and the Ministry of Livestock and Fisheries.

### Traditional Farming Sector

Traditional agriculture is generally determined by the climatic conditions and diet of the population of a given region. This sector is concerned only with commonly eaten crops: rice, maize, yams, plantain, and traditional vegetables. Most crops produced are consumed on the farm.

Cultivation practices are unsophisticated (hoes/dabas, machetes, ox-drawn ploughs). The varieties grown are local and hardy, but their productivity is low, and production levels are consequently low. However, this sector remains important, since 90 percent of the rural population is engaged in traditional agriculture. Because of their sheer

numbers, small farmers now form the basis of national food production.<sup>1</sup>

Traditional farms may grow several stands of citrus trees, mango trees, and papaya trees, and even more or less well maintained orchards producing in excess of on-farm consumption. Fruits are exported to Sahelian countries (Sénégal and Mali). However, we are unable to give export figures here, for the same reason as that stated above and also because this trade was initiated by the private sector and is not controlled by the government.

#### Joint Private/Government Projects

These are integrated agricultural development projects which include activities by the farmers and activities conducted by a government agency.

An example of such a project is the Daboya project for the production of fresh pineapple. This project includes an industrial plantation with a total area of 500 ha, and groups of village plantations located within a radius of 15 km. The industrial plantation (plantation industrielle, or PI) is a state corporation, and all of its personnel (except for temporary workers) are government employees.

All investments in the industrial plantation (development of land, irrigation infrastructure and equipment, buildings, farming implements and supplies, vehicles) were the responsibility of the state; the operating budget is also funded by the state.

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1. The unavailability of statistical data precluded our citing specific figures.

# II-73.

Investment costs amounted to US\$11.5 million at the time of completion of the work (in 1976), and were financed jointly by the World Bank and Government of Guinea.

The industrial plantation now has 425 ha under cultivation, divided into three plots of slightly over 140 ha each. It currently employs 250 persons, and results are encouraging: yields have increased and production costs have been lowered (see Exhibit II-7).

Exhibit II-7. Production Costs and Yields  
per 140 Hectare Plot, Daboya Project

Year	Area (ha)	Production (tons)	Yield (tons/ha)	Production cost (Syllis <sup>a</sup> /kg)
1976	35	1,200	34	-
1977	25	1,000	40	-
1978	60	2,400	40	-
1979	70	2,800	40	-
1980	80	3,200	40	-
1981	80	3,200	40	7.2
1982	140	8,000	57	7

a. At the official rate of exchange (December 1982),  
S 22 = US\$1.

The village plantations, distributed as satellites around the industrial plantation, were abandoned colonial farms or newly created farms at the local farmer level. The owners of these village plantations form "voluntary groups" averaging 12 persons each. Their farms average 30 ha, divided into three blocks of about 10 ha each.

Government intervention at the village plantation level consists of:

- . Performance of work which the farmer cannot do himself: land clearing, ploughing, pesticide application, ordering agricultural inputs;
- . Technical supervision of farmers: advice as regards compliance with cultivation and pesticide treatment schedules, harvesting, training in cultivation practices; and
- . Organization in common for harvesting and marketing.

At present, four voluntary groups are in full operation, and results (yields, production costs) are similar to those achieved by the industrial plantation. There is much interest in the program among farmers in the area; two new groups are to be established in the near future, and further expansion is planned.

"Cayenne Lisse" and "Baron de Rothschild" are the two varieties grown on both the industrial and village plantations of the Daboya project. Production is sold on the export market (80 percent) and the domestic fresh fruit market (20 percent); it is sometimes sold to the SALGUIDIA plant to be processed into juice, in the event of surplus production and poor sales on the international market.

The production is marketed by the FRUITEX state corporation, which buys pineapples at 7.6/kg in bulk and 9/kg packed.

### Government Projects

FAPAs and FACs (Fermes Agricoles Communales) are typical examples of government projects. They are state farms or corporations, usually serving multiple purposes. They are financed by the state; the government develops the programs and determines the goals to be attained, and personnel responsible for implementing the programs are government employees. The production of these units is, theoretically, meant to supply government stores.

These projects include fruit and vegetable production programs designed to increase domestic production and reach food self-sufficiency. Precise information on their operations and production system was unavailable.

### Production Level

Unfortunately, no data were available on levels of production in Guinea, except for fruit production as recorded in the Annual Agriculture Report. These data are given in Exhibit II-8.

To meet total domestic needs in the coming decade, and eventually to export surplus production, Guinea will need to triple, if not quadruple, its present production. The Government of Guinea is consequently considering large-scale projects over the next decade.

### Processing Facilities

There are four fruit and vegetable processing plants in Guinea, of which three are in operation at present.



Exhibit II-8. Fruit Production  
in Guinea, 1975-80

Year	Bananas		Pineapple		Mangoes and Citrus Fruit		TOTAL (tons)
	Area (ha)	Production (tons)	Area (ha)	Production (tons)	Area (ha)	Production (tons)	
-----Thousands-----							
1975	21.7	94.8	14.2	141.7	35.1	45.8	282.3
1976	21.3	95.9	14.3	143.0	35.4	160.2	399.1
1977	N.A.	N.A.	14.5	144.5	34.5	451.8	-
1978	21.7	97.8	14.8	145.9	35.1	456.3	700.0
1979	24.7	98.7	14.8	147.4	35.9	467.1	713.2
1980	22.2	91.7	14.9	148.9	35.8	465.3	705.9

#### SALGUIDIA

The SALGUIDIA pineapple and citrus processing plant is a joint venture of the Guinea and Libyan governments. It began partial operation in 1981-82, but is expected to be in full operation during 1983. Products will include pineapple slices and juice, concentrated citrus juices, citrus oils, and mango juice. Processing machinery is new and modern. The facility also includes refrigerated storage and a can-making plant.

Pineapple will be obtained from a company-owned plantation. The planted area is now only 35 ha, but eventually 1,000 ha will be devoted to pineapples (with about 300 ha in production at a time). This will require construction of a

dam on the local river, plus a distribution system. A loan from the government is to be obtained to finance this construction. Additional supplies of pineapple are to be obtained from local farmers organized in the form of a cooperative. Planting material has already been supplied to a number of these farmers. Pineapple is also being obtained from the government plantation at Daboya (rejected fruit from its fresh export operations). In a 6-month season, it is expected that 6,000 tons of pineapple will be processed in single-shift operations (12,000 tons on two shifts). Further details on this enterprise are given in Appendix A (Profile No. 6).

Production costs at this plant, which would permit comparison with other African processors, are not yet available. The Libyan Government is expected to be a major buyer of the product, and as part owner of the plant can be counted on as a "captive customer." How competitive the products might be on world markets remains to be seen. Pineapple juice will be exported also to West African countries, while slices will more likely be exported only to other areas.

#### Kankan Fruit Juice Factory

This plant reportedly produces juice from oranges, papaya, mango, and grapefruit. Unfortunately, time did not permit a visit to the site, nor were we able to obtain information on production or marketing.

#### SIPAR, Labé

The SIPAR plant is a long-established private venture producing essential oils from citrus fruit and flowers. Among the citrus fruit utilized are bergamot, bigarade, and

lemon, mostly grown on the company's own plantations. The oils are exported to France.

#### Mamou Cannery

The "Conserverie de Mamou," now closed and slated for renovation, formerly produced tomato paste, fruit juices, and jams. Future plans for this plant are discussed below.

#### New Project Planning

#### Mamou Cannery

Guinea is actively seeking financing for the renovation of the Mamou cannery. The plant, originally equipped with Russian machinery, ceased operations several years ago due to machinery breakdowns and other technical problems. A detailed feasibility study is required to determine the scope of the project and any desirable changes in product mix. Current planning is as follows:

	<u>Tons per year</u>
Orange juice	3,360
Tomatoes	280
Jam	1,200
Preserved fruits	800

Raw materials would include citrus fruit, mangoes, and tomatoes. The small figure for tomatoes, if correct, suggests that only tomato juice would be produced, not tomato paste. However, Ministry of Industry officials inform us that plans include the production of tomato paste as well as the processing of vegetables (squash).

Investment costs have been estimated as US\$5 to US\$6 million. We did not succeed in obtaining copies of previous studies on the Mamou cannery to learn more about the process.

#### Fruit and Vegetable Processing Plant, Linsan

This project was presented to a 1981 conference of aid-donor agencies. A feasibility study has already been prepared by an Italian firm, TECNAL. The plant, estimated to cost US\$8 million, would produce concentrated fruit juice and canned vegetables. It would be associated with a 170 ha plantation of fruit trees and vegetables.

It seems unlikely that both the Linsan and the Mamou project would be implemented, as they are in the same general area. Presumably the proposed feasibility study will look at both projects and recommend one only.

#### National Plan for Fruit and Vegetable Development

After declining somewhat during the last two decades, Guinean agriculture is now turning around. However, the rate of growth in production levels is low (1 percent annually) and is insufficient to keep pace with needs, which are increasing in proportion to population growth (2.8 percent annually). Consequently, the government has developed an extensive agricultural program, with the following objectives:

- . Food self-sufficiency in the short and medium term; and

- . Surplus production for export before the year 2000.

This program includes various types of projects and encompasses the entire country:

- . Development of areas with a strong potential for the growing of grain crops, fruit trees, and forestry in lower Guinea, upper Guinea, and the forest region;
- . Reclamation of highlands and development of water resources;
- . Investment in development activities at the local farmer level (agricultural extension, structuring, technical support, supply of agricultural implements and inputs);
- . Reinforcement and establishment of agricultural research stations; and
- . Production and multiplication of seeds selected for all four eco-climatic zones.

Projects based on specific activities either have already been studied or are now under study. The necessary financing has been obtained for some of them.

### Research

Agricultural research has been conducted for more than 20 years in Guinea, mainly by INRAF at Foulaya (Institut Nationale de Recherche Agronomique de Foulaya). Established in 1958, INRAF was originally designed to conduct fundamental research along the following lines:

- . Study environmental conditions for the selection and improvement of the planting stock;
- . Study plant diseases; and
- . Conduct genetic research for the creation of new varieties and maintenance of existing planting stock.

However, following the extension of the experimental station, the institute has concentrated increasingly on the production of fruit, which led to the creation of the present Production Division. As a result, INRAF produces mangoes, bananas, pineapple, and citrus fruit, which are marketed by FRUITEX.

INRAF also conducts research on the preservation of food products and on processing technology. It now has an artisan processing unit for producing gari from cassava. In addition, INRAF has a third division, the Training Division. This is the agricultural department responsible for training engineers.

The new programs which were developed by the National Scientific Conference in December 1981 make this institute a key element in the major agricultural development projects planned for the next decade.

APPENDIX A

PROFILES OF WEST AFRICAN  
FRUIT AND VEGETABLE  
PROCESSING PLANTS

PROFILE NO. 1

NAME: Conserverie de Fruits et Légumes de Sinématiali  
 LOCATION: Sinématiali (Ferkéssédougou), Ivory Coast  
 DATE OF VISIT: 8 November 1982

1. General

This state-owned enterprise under the direction of SODEFEL produces tomato paste and mango juice. The plant was completed in 1978 and started operations in March 1979. It is associated with an 1,800 ha farm where tomatoes are grown in rotation with other crops for local consumption.

2. Raw Material Supply

The farm, also under SODEFEL's direction, is managed by a French technician, M. Henri Anguille (an agronomist attached to SATEC, Paris). The 1,800 ha area is divided into 10 roughly equal blocks, of which one is reserved for experiments and one for a plant nursery. The remaining area of approximately 1,500 ha is devoted mainly to tomatoes, corn, and a "cover crop" on a 3-year rotation, plus smaller areas of crops for local consumption. Crop areas at present and reported yields last season are as follows:

Tomatoes	400 ha	(28 tons/ha)
Corn	500	( 3 tons/ha)
Rice	200	(1.5 tons/ha)
Groundnuts	50	?
Igname	50	(10-12 tons/ha)
Fallow		
(or cover crop)	<u>300</u>	-
Total	1,500 ha	



All tomatoes are delivered to the plant, and 80 percent of the corn is sold on local markets. The remaining production is consumed by farmers working the land.

The individual blocks of land are worked by groups of 60 to 70 farmers (a total of 544 farmers on 8 blocks). Working under the direction of M. Anguille are four managers (Chefs d'Unité), each responsible for two blocks, and two technicians or extension agents (encadreurs) for each block. The blocks are in the process of being transferred to co-operatives (GVC or Groupement de Vocation Coopératives) composed of farmers who work the land. They will be headed by a president elected by the members. Farmers and their families will live in villages now being constructed at the site. At this time, the system seems to be working well.

Each block is equipped with two tractors and various implements which are stored in a shed along with fertilizer and other supplies. Sheds are also being used for storage of shelled corn and paddy, which are now in piles on the earth floor of the shed due to lack of silos.

Five varieties of tomato are grown: Napoli, Royal Chico, Roselle, Ronita, and UC82A. These include early and late varieties as well as high yielding varieties and those that process better. Planting and harvesting are timed to spread deliveries to the plant over the period from early December through April, and to achieve the desired quality of concentrate. Harvesting is done manually, four times for each field.

The plant manager informed us that it is planned eventually to increase the area planted to tomatoes to 600 ha. We understood that this can be accomplished as training

of farmers and managers proceeds. The necessary land is available if corn harvesting is completed earlier -- to do so, additional harvesting equipment is needed since much is still done by hand. Average yields for the 1982-83 season should be 28 tons/ha; they are expected to reach 30 tons/ha easily next year. (Yields of 40 tons/ha are reported at an adjacent experimental farm.)

Separate accounting is maintained for each block. Credit for tomatoes delivered is given at the rate of CFA 28/kg (1982-83 season); the block is debited for water, fertilizer, chemicals, fuel, etc., and for the use of any centrally maintained equipment, such as corn harvesters. Production costs for tomatoes are reported as CFA 13 to CFA 15/kg (excluding any amortization for development of the area or for technical assistance). Farmers are reported to realize an annual income of CFA 200,000 to CFA 220,000, although this should reach CFA 250,000 when tomato production and yields increase further. (At CFA 200,000, this is about 10 percent more than an agricultural worker would get if he worked six days/week year round at the going rate of about CFA 600/day.)

Mangoes are purchased from farmers in the surrounding area.

### 3. Plant Operations

Information was obtained from the plant manager, M. Kasimir Gnacadjé.

The production record of the plant since start-up is reported as follows:

<u>Season</u>	<u>Input</u> (tons of tomatoes)	<u>Output</u> (tons of 28% concentrate)
1978-79 (partial)	800	100
1979-80	3,000	500-600
1980-81	6,000	1,000
1981-82	9,000	1,300-1,400
1982-83 (projected)	12,000	2,000

Figures are approximate. A conversion ratio of 6.4 to 6.9 for 1981-82 was attained, while a ratio of about 6 is projected for next year. '

There are two lines, one handling 9 tons/hour of tomatoes, the other 5 tons/hour, for a total of 14 tons/hour. They are equipped with two-stage Manzini evaporators. Fillers and closers are also by Manzini. Maximum output of the plant operating three shifts/day, 6 days/week for 16 weeks would be 4,000 tons of concentrate.

Personnel include 10 full-time and 100 seasonal workers, the latter earning CFA 600/day.

Tomatoes have been delivered in lug boxes and hand dumped into water. Next season bins will be used; a bin-dumper is being constructed which will dump into a water flume.

Operating costs were reported to be CFA 270/kg of concentrate. Amortization and other fixed costs for the plant were not available. However, a recent study of processing costs in the Ivory Coast reported total production costs at Sinématiali of CFA 408/kg of paste, including depreciation, interest, and all fixed costs.

Concentrate is packaged in five sizes of cans with paper labels. Empty cans are trucked the 600 km from Abidjan by SODEFEL, and cases of final product are carried on the return trip.

#### 4. Sales

All sales are handled through SODEFEL, which distributes the product domestically. Can sizes and prices are as follow:

<u>Can size</u>	<u>Cans/carton</u>	<u>Price/carton ex-factory, CFA</u>	<u>CFA/kg</u>
4,500 gm.	6	9,180	340
3,300	6	6,960	350
800	24	8,400	400
440	48	9,120	430
140	96	6,000	450

The actual product mix is not known, but the average price appears to be approximately the same as the CFA 400/kg cost figure mentioned above.

As of May 1982, Italian concentrate could be delivered to Abidjan for CFA 160/kg. Tariffs and taxes add 86 percent to this figure, and local handling brings the wholesale price to about CFA 320/kg. This compares to CFA 420/kg for paste from Sinématiali delivered in Abidjan.

The government is considering a scheme to add further taxes on imported paste, which would subsidize locally produced paste, thus equalizing sales prices.

PROFILE NO. 2

NAME: SAFCO PINEAPPLE CANNERY  
LOCATION: Tiassalé, Ivory Coast  
DATE OF VISIT: 10 November 1982

1. General

This privately owned pineapple plantation and cannery is one of three pineapple operations in the Ivory Coast. (The others are SALCI at Ono, and Nouvelle SIACA at Bonoua.) It is owned by a company called SAFCO. We interviewed the administrative director, a Swede named Bergman.

2. Raw Material Supply

The company owns a 350 ha plantation, of which one-third is in production at any one time. Yields last year were about 40 tons/ha, which is considered low in comparison to a more normal 60 tons/ha. About three-quarters of the fruit processed comes from small planters in the surrounding area who are paid for fruit on a scale fixed by the government: CFA 13/kg at the farm, and CFA 15/kg delivered to the factory. SAFCO assists these farmers by supplying them with fertilizer and agricultural chemicals on credit, and giving some technical assistance.

For the 1981-82 season, 15,200 tons of fruit were processed and an additional 2,500 tons sold fresh. Due to lack of rain, production in the area was down, and SAFCO had to purchase 6,500 tons of fruit from SOFETEL and transport it from the coast (cost: CFA 9/kg).

For the 1982-83 season, production of 18,000 tons is forecast, all from the local area. The use of a plastic covering (mulch) to conserve soil moisture and reduce weeds is planned.

3. Plant Operations

Both juice and slices are canned, in roughly equal proportions. Average production costs were given as CFA 170/kg (juice and slices). Cans are trucked from Abidjan.

4. Sales

Juice sales are 25 percent to Europe, 35 percent to neighboring countries (mainly Upper Volta and Niger), and 40 percent to the Ivory Coast.

Slices go 90 percent to Europe and 10 percent to neighboring countries (Niger and Sénégal).

Canned pineapple suffered a 30-40 percent fall in price in 1979. During these recession years, a lower-priced product -- mainly from Thailand -- has taken a large share of the European market. All pineapple processors in the Ivory Coast have been hard-hit by this development.

Minimum export and domestic prices (floor prices) for canned pineapple from the three Ivory Coast producers are agreed upon under a "cartel" arrangement and monitored by the government.

PROFILE NO. 3

NAME: Usine de Transformation de Manioc (I2T)  
Operation Manioc de Toumodi (SODEPALM)  
LOCATION: Toumodi, Ivory Coast  
DATE OF VISIT: 10 November 1982

1. General

These two separately administered projects are linked as supplier-processor of manioc (cassava). Both are still in the experimental stage.

2. Raw Material Supply

The Assistant Director of Operation Manioc, M. N'Da Isadore, was interviewed. SODEPALM began operations six years ago; the first plantings were in the 1976-77 season.

The project was conceived as "agro-pastoral"; planting of manioc would be rotated with forage crops used to feed lambs. The project would assist farmers by mechanized planting and harvesting of manioc, which would lower costs and increase yields. Lamb-raising has not been successful thus far since the project was not adequately equipped to deal with livestock.

Work on manioc has shown the importance of the correct soil moisture (not too wet) and of good weed control. Neither mechanized planting nor harvesting has yet been developed successfully. Imported harvesting machinery, modified locally, leaves too many roots in the ground. Planting machinery (to handle the stalk planting material)

was imported from Brazil and modified locally but has not given satisfactory results. Most recent planting and harvesting operations have been carried out manually.

Plantings of manioc were as follow:

1979	200 ha
1980	160 ha
1981	49 ha
1982	80 ha

Planting is in 2.5 ha blocks assigned to groups of farmers.

A two-year growing cycle was planned but harvesting has slowed due to the inability of the processing plant to accept more product. Only 107 ha of the 1979 planting and 45 ha of the 1980 planting have been harvested. Yields were 27-28 tons/ha from the former and 20 tons/ha from the latter. (It was noted that a 14-month growing cycle is the minimum feasible.) Yields from fields planted and harvested entirely by hand were not perceptibly different from those planted and harvested by machine.

Prices fixed by the government for roots are CFA 10/kg delivered to the factory, or CFA 7/kg in the field. Present production cost for mechanized growing is estimated at CFA 12.5/kg. Manioc not purchased by the factory is being sold in Abidjan at CFA 13/kg, but a transportation cost of CFA 7/kg is incurred. It is hoped to reduce production costs to CFA 10/kg by improved varieties and cultural practices.

### 3. Plant Operations

The Assistant Director, M. Kouakou Jacques, was interviewed.



This small experimental plant began operations in 1980. It is now running intermittently on small batches to test various peeling methods. Products include manioc flour, attiéké, and gari. The flour process consists basically of peeling, washing, chopping, disintegrating, drying (by hot air), and grinding. The present steam-hot air system is considered too costly. Plans are to go to direct heating by burning methane gas generated by a biomass system.

Production costs are presently estimated at CFA 100/kg of flour. Fuel costs are 10-15 percent of this and are considered to represent the chief way of reducing costs.

Yields of flour are said to be 22 percent of the weight of roots. Yields of 20-25 percent are considered to be normal, the variation being mainly due to the variety and age of the manioc roots.

There are separate small lines for producing attiéké and gari, both granular pre-cooked forms of manioc. The production cost for attiéké was given as CFA 250 to CFA 300/kg.

PROFILE NO. 4

NAME: Consortium de Côte d'Ivoire (COCI), COPAGRUM  
LOCATION: Sassandra, Ivory Coast  
DATE OF VISIT: 2 December 1982

1. General Observations

Cultivation of citrus fruits in the Sassandra region started in 1957-58 in the form of family production units established by European colonists. Each family owned a small workshop for essential oil extraction. From 1965 on, expansion of this crop was due to the establishment of plots by former workers from European plantations.

The Government of Ivory Coast (GOIC) first intervened in 1969 by creating COCI (Consortium de Côte d'Ivoire), a mixed corporation in which the shares were distributed among the Ivorian Government, companies incorporated under the laws of the Ivory Coast, French organizations, and planters.

However, as a result of financial difficulties stemming from poor sales from 1974 on, the GOIC was forced to intervene at both the production and processing levels.

2. How Production Is Organized

The need to organize production resulted in the creation of COPAGRUM (Coopérative des Producteurs de Plantes à Parfums et d'Agrumes - Essence-Yielding Plant and Citrus Fruit Producer Cooperative) which at present is made up of 186 registered planters, 125 of whom are actually engaged in production.

Classes of COPAGRUM planters:

Ivorians	68
Non-Ivorian Africans	45
Europeans	<u>12</u>
Total	125

Nineteen extension agents (six for administrative and financial services and 13 for technical services) are charged with instructing and assisting planters. The salaries of these personnel are at present paid by the cooperative. Their responsibilities are as follows:

- . Establishment of cooperative facilities;
- . Counseling and sensitizing planters to decrease abandonment of citrus plantations, and to promote the reconversion of plantations to give a new impetus to citrus fruit cultivation;
- . Technical supervision of planters through extension work on farming methods;
- . Monitoring BNDA loans granted to planters;
- . Establishment and management of the nursery;
- . Organizing produce transportation;
- . Farming equipment maintenance (machines and miscellaneous implements); and
- . Management of a gas station established by the cooperative.

The three varieties grown are lemon, bergamot orange, and bigarade orange, and results are encouraging:

A-13.

Item	Area under cultivation (ha)	Yield (tons/ha)	Production
Lemon	2,000	20	All year
Bergamot orange	500	50	2 crops a year
Bigarade orange	500	20	2 crops a year
Total	3,000		

The company's capital, amounting to CFA 5 million, is entirely paid up.

Changes in Fruit Production  
1971-82 (tons)

Year	Lemon	Bergamot orange	Bigarade orange	Total
1971-72	14,850	7,200	2,200	24,250
1972-73	14,190	4,500	2,200	20,890
1973-74	24,350	7,000	1,500	32,850
1974-75	30,000	11,000	2,000	43,000
1975-76	38,000	7,300	2,000	47,300
1976-77	25,000	6,000	1,000	32,000
1977-78	22,000	3,300	800	33,300
1978-79	14,500	2,700	800	18,000
1979-80	15,000	2,700	400	18,000
1980-81	24,000	3,000	1,300	28,300
1981-82	20,000	3,000	1,300	24,300

### 3. Processing of Citrus Fruits

#### History

Processing of citrus fruits used to be done on a small scale in family workshops. In the process, only the essential oils of lemon, bergamot orange, and bigarade orange were extracted.

After the slump of 1974-78, the GOIV intervened to reorganize both production and processing. In 1979, COCI (Consortium de Côte d'Ivoire) was created with the establishment of a large capacity (60,000 tons/year) plant capable of processing total planter output and outfitted with four production lines -- two for processing lemon, one for bergamot orange, and one for bigarade orange.

The plant's capital was initially distributed among the GOIC (16.68 percent), planters (5.6 percent), and private industrial groups -- both Ivorian and foreign (77.72 percent). However, since 1979, the GOIC has reassigned its shares to the planters, who at present own 68 percent of the shares, as opposed to the mostly French industrial groups (S.O.M.D.I.A., ORANGINA, SHELL, UNIPLECTINE, MERO and BOIVEAU), which own 32 percent of the shares.

#### Manufactured Products

Essential oils are extracted from all varieties of citrus fruits (lemons, bergamot orange, and bigarade orange). However, only lemons are further processed to yield concentrated lemon juice and marpectin made up of ground and dried lemon endoderm and rind.

These products are used for:

- . Essential oils: perfume industry, biscuit making, cosmetics;
- . Juice: an ingredient of non-alcoholic beverages and cakes; and
- . Marcpectin: gelatin (drug industry), animal feed.

### Plant Design Characteristics

The capacity of the plant is 200 tons/day, and 60,000 tons/year of processed raw materials. There are four production lines -- two for lemon, one for bergamot orange, and one for bigarade orange. The plant has a laboratory for final product analysis and quality control.

### Plant Operation

Organizing plant procurement is performed by the Plant Director in conjunction with COPAGRUM's harvesting schedule.

The fruit are transported by the planters themselves or by the cooperative. Prices paid to planters are CFA 15/kg for lemon and bigarade orange, and 18 CFA/kg for bergamot orange.

Present production, which is 24,000 tons/year, represents less than half of plant capacity of 60,000 tons/year. The reason is that planters have discontinued cultivation of citrus fruits as a result of the 1974-78 slump, and that stands are aging, some being more than 15 years old. COPAGRUM is therefore considering the establishment of continuous new plantations within a radius of 25 kilometers

around the plant. This project will make it possible to improve procurement and to operate the plant at full capacity.

The average production cost is about CFA 16.11/kg of fruit.

The intervention by GOIC has been very beneficial. Except for negligence on the part of a few planters, a few cases of disease (gummosis), and attachment on trees of loranthus, a parasitic plant, both yields and total production have been increasing since 1980. Indeed, the co-operative's gross revenue increased from CFA 226,400,000 in 1979-80 to CFA 420,600,000 in 1980-81; it will most probably exceed CFA 500,000,000 in 1981-82.

Changes in Plant Production  
1972-81 (tons)

Year	Essential oils	Juice	Marcpectin	Total
1972-73	129	772	--	901
1973-74	151.9	507	--	658.9
1974-75	224.6	284	934	1,442.6
1975-76	200.9	301	607	1,108.9
1976-77	149.6	220	598	967.6
1977-78	121	258	752	1,131
1978-79	181.1	112	341	634.1
1979-80	78.5	369	195	642.5
1980-81	121.6	1,100	775	1,996.6

PROFILE 1 . 5

NAME: Vegetable and Fruit Processing Ltd. (VEG-FRU)  
LOCATION: Near Gombé (Borno State), Nigeria  
DATE OF VISIT: 23 November 1982

1. General

The 400 acre farm and the processing plant are located about 45 km east of Gombé (Bauchi State), just over the border in Borno State. It is a privately owned venture, part of the INLAX group owned by Mr. Chivisani, a gentleman of Indian origin living in London. Local management of INLAX and VEG-FRU is by Indian nationals. In accordance with Nigerian law, these are now joint ventures with Nigerian partners, 60 percent in the case of INLAX, 40 percent for VEG-FRU. Products are tomato paste, tomato juice, and mango juice, all of which is sold on the Nigerian market.

2. Raw Material Supply

Tomatoes are obtained from the company's own fields plus outside purchases. Approximately 700 acres of tomatoes were grown in the 1981-82 season. At average yields of 8 to 10 tons/acre, about 7,000 tons of tomatoes were produced. An additional 6,000 tons were purchased, half from local farmers and half trucked from an agricultural project near Kano (Hadejia-Jamaara River Basin Development Authority). Plans are to process 15,000 tons in the 1982-83 season, mainly through expansion of their own farm. Ten thousand tons is regarded as the maximum production from 1,000 acres. The objective is to reach 15 tons/acre, but 10 tons/acre (25



tons/ha) is regarded as more attainable. Purchases from local farmers are made through a network of 15 buying stations. The price last season was ₦0.1/kg; this will be increased to ₦0.12/kg for 1982-83. Most farmers have 1/4 to 1/2 acre plots along river banks. With yields of 5 tons/acre, farmers can earn ₦600/acre this year, against a cost of about ₦200 for subsidized fertilizer and chemicals. No irrigation is used.

Tomatoes are grown on a three-year rotation to avoid nematode problems, with the land left fallow in the second and third years. Irrigation water is pumped from a nearby river through steel pipe (which is made at the site); crops are irrigated by trenches. All operations are manual except that tractors are used for plowing and digging of the main trenches. Transplanting of bare-root seedlings is by hand. We observed this operation being done by crews of young boys, who are paid ₦2/day. Varieties include Roma VFN (120 days), Russell (150 days), Cal J, Pectomag, C-38 and C-34. Planting is done from August to December, though mostly in October and November since heavy rain damages the early plantings. Harvesting is from mid-January to mid-April (3 months). Fertilizer is applied by hand; spraying is done with motorized knapsack sprayers. Weeding is contracted out to crew bosses who receive ₦20/acre.

The farm was purchased from a Nigerian Lebanese company (NADIL) in 1971. It was originally devoted to cotton growing. Temperatures are considered rather high for tomatoes. Production is satisfactory when the daily temperature range is 15° to 35° C, as it has been this year. When the range reaches 22° to 40° C, the heat causes dropping of the flowers and fruit formation is reduced.

An area of 100 acres is used for vegetable production for local sale. These vegetables include melons, cucumbers, squash, okra, eggplant, chick peas, string beans and peas, although temperate climate crops such as peas are subject to mildew.

### 3. Plant Operations

The processing plant is equipped with Italian machinery procured piece-meal by Italian friends of Mr. Chivisani. Manufacturers include Buscetto, Cuomo, Manzini (evaporators), and Rossi-Catelli (pulper).

The process uses a cold break system and consists of dumping onto a water flume (by hand from 10-gallon cans for farmer tomatoes or by dump truck for the rest), sorting, pulping, skin and seed separation, pre-heat, pre-concentrate, concentrate (batch system), fill, seal, sterilize (draper-type), and pack. Most of the product is packed into 70 gm lithographed cans made in an adjoining can plant from plate imported from Italy (already lithographed). Can-making machinery is also Italian.

The plant is not well laid out, and recently acquired equipment has been fitted in as space permitted. Transfer of paste is in open carts from evaporator to the filling and closing line. Plans for next year are to acquire an Angelus closer (400 cpm) and a new sterilizer, and to rationalize the entire layout. This should permit production to reach 1 million cans/year.

The plant operates eleven months a year with a permanent work force of 350 (average wage: M170/month). Off-season canning is accomplished by storing excess production during

the season in 50 gallon drums lined with polyethelene bags. Before sealing the bag, salt is added to the surface of the paste to retard spoilage. Even so, something in excess of 10 percent of every drum is discarded due to mold after storage of up to 6 months.

Concentration is 28 percent for directly canned paste. Paste to be stored is concentrated to 32 percent, then diluted to 28 percent for canning off season. Conversion ratio averages 7 to 1. Three canning lines are running at a total of 200 cans/minute, or 2,250 cartons/day of 20 hours (two shifts of 10 hours each).

Approximately 50 percent of paste processed is imported from Spain in lined 50 gallon drums. These drums are apparently aseptically filled and losses of product are minimal.

In 1981, canning of tomato juice in 154 cl cans was started; mango juice was added in 1982. Mango pulp has been imported from other African countries, though local purchase should be possible when new orchards in the area come into production.

The production record is as follows:

Year	Cartons of tomato paste	Paste equivalent, tons	Cartons of tomato juice	Cartons of mango juice
1977	301,000	2,107		
1978	355,000	2,485		
1979	480,000	3,360		
1980	696,000	4,872		
1981	546,000	3,822	54,000	
1982	643,000	4,501	37,500	300,000

A-21.

Cartons of tomato paste contain 100 cans of 70 gm; juices are packed in 154 cl cans, 48 to a carton.

A small portion of the pack goes into 3 kg cans for hotel use.

Processing cost was given as ₦12/kg of paste, of which ₦9 is for direct processing costs, and ₦3 for interest, depreciation, and administrative and selling costs. Costs for can making alone come to about ₦3/kg of paste.

#### 4. Sales

The wholesale price per carton of paste was given as ₦16, which works out to ₦23/kg or ₦0.16 per 70 gm can. We observed cans on retail sale in a Lagos supermarket at ₦0.25 each. This is roughly twice the cost of locally made paste in the Ivory Coast (at official rates of exchange).

The variations in production cited in the preceding section in the 1980-82 period were sales related. Strong competition from cheaper imported canned paste has been experienced. This varies in intensity according to government policy on imports, which has fluctuated strongly in recent years. The company was badly hurt by liberal import policies in 1980, forcing cut-backs in 1981 production. Since then import restrictions and tightened surveillance of smuggling has helped, so that 1982 production was increased almost to 1980 levels.

VEG-FRU management estimates Nigerian demand at 2 million cases annually, made up roughly of 600,000 cases of VEG-FRU product, 800,000 cases legally imported, and 600,000 cases illegally imported.

Management reported that paste is available in Italy and East European countries at US\$5 to US\$6/carton, which is regarded as a subsidized price. This works out to about US\$8/carton delivered in Nigeria, or ₦5/carton at official exchange rates. Import duties currently at 100 percent plus handling bring the wholesale price to ₦14-15/case, which is close to but still under VEG-FRU's ₦16 price.

Sales of tomato and mango juice have been disappointing so far. Apparently, Nigerians have not developed a taste for canned fruit juice, preferring soft drinks.

5. Future Plans

Beyond the increased tomato plantings mentioned above, VEG-FRU management does not plan any large increases in tomato paste production due to market uncertainties. Instead there are plans to broaden their product line with a beans-in-tomato sauce formulation.

PROFILE NO. 6

NAME: SALGUIDIA  
LOCATION: Near Forécariah, Guinea  
DATE OF VISIT: 8 December 1982

1. General

SALGUIDIA is a joint venture of the Libyan and Guinean Governments. It will produce canned sliced pineapple, pineapple juice, mango juice, and concentrated orange juice. Capital of the company is reported to be US\$10 million, 50 percent contributed by each country. Management positions are shared equally between Guineans and Libyans. The assistant director, who acted as our host, is a Libyan. Translation from Arabic to French was done by the Guinean farm manager, who studied agriculture in Egypt.

The company took over the assets of the former SIFRA, which at one time was privately owned and was later nationalized. SIFRA had purchased the former French-owned firm COPROA, which operated a plantation and cannery in the area in the 1960s. The present building, and all equipment except the can-making line, are new.

The company was formed in 1977 as a "Société Mixte," and under Guinean law operates independently of the Guinea Government, i.e., it is not under the direction of any state enterprise or agency. As an autonomous agency, it is allowed to import and export on its own account. (As we understand it, the enterprise is entitled to retain 50 percent of its foreign exchange earnings.) This past season was the first

for the new company. Only pineapple juice was produced during a 2-month period.

## 2. Raw Material Supply

Pineapple to supply the plant will be obtained partly from the company's own plantation and partly from purchases from farmers. An area of 2,000 ha is under control of the enterprise, of which about 1,000 will be planted with pineapples. With the 3-year cycle common to pineapples, about 300 ha will be in production in any one year. At an expected 60 tons/ha, this would produce 18,000 tons annually. At this point, 35 ha are actually planted, though this figure is expected to reach 50 ha within the next few months based on shoots (rejets) already available.

Irrigation is by overhead sprinklers with water pumped from nearby streams. This system will not suffice for more than 150 ha. Plans have been made to construct a dam on the nearby River Killi, which could provide enough water to irrigate the entire 2,000 ha. Based on a study done by engineering consultants, a loan is to be obtained through the Guinea Government for the project. Repayment will be made out of earnings from export of canned pineapple. Management could not say if the loan had been finalized. Pineapple varieties include "Baron Rothschild" and "Cayenne Lisse" in mixed plantings, 60,000 plants/ha. The farm manager told us that they are using hormonal sprays to accelerate flowering and that this produces fruit 13 to 14 months from planting instead of 18 months. Thus they hope to shorten the 36-month cycle by several months. Planting is in blocks 36 m x 36 m, which allows spraying of herbicide and hormone sprays from tractor-mounted 18-m boom sprayers.

About 30 local farmers are being organized into a growers' cooperative. Depending on the size of their holdings, they should be able to deliver between 10 and 150 tons per season, or roughly 2,000 tons total. SALGUIDIA will supply shoots to the farmers weighed and sorted to give each farmer shoots of uniform size. Fertilizer and chemicals are to be supplied on credit against fruit deliveries.

Deliveries are also expected from farmers in the Kindia area who are members of a regional cooperative, some with fairly large plantations. The state-owned plantation at Daboya with 450 ha of pineapples will deliver excess or rejected fruit from its fresh exports, as it did last year. At least 2,000 tons per season should be available from this source. Quantities available from the regional cooperative are unknown.

SALGUIDIA will begin processing mangoes and citrus fruits next season. A nursery has been started and distribution of seedlings to local farmers should begin soon. In the meantime, fruit will be purchased from cooperatives and private farmers in the local area and from around Kindia.

### 3. Plant Operations

The processing plant, together with can-making line, cold stores, and warehouse, is housed in a new steel frame building of about 40 m x 80 m. Processing equipment consists of a pineapple line, a citrus juice line, and a mango juice line.

The pineapple line has a capacity of 5 tons/hour of fruit processed into canned slices and juice. The line



includes all new equipment for peeling/coring/slicing pine-apples, a conveyor line for hand-filling of slices into No. 2 cans, a Hema syruper, Angelus closer (135 cans/min.), rotary cooker/cooler (Hema), and a semi-automatic caser.

Juice extracted from undersize fruit and peeling/coring wastes passes through a pasteurizer, a Ferrum piston filler, a 425 can/minute Ferrum closer, and a tunnel sterilizer. Cans are 175 ml with pull tab opening.

The citrus line has a capacity of 3 tons/hour of orange, lemon, or grapefruit. Fruit passes through a citrus oil and juice extractor (Polycitrus of Italy) which scrapes the skin of the fruit and washes oil and peel away for further treatment, then presses juices from the fruit in a second step. Juice is pasteurized and concentrated, then filled in 60 or 120 liter drums.

The mango line consists of pulper/finisher and pasteurizer and its capacity is 4 tons/hour. Full-strength juice passes to the drum filling line (in common with the citrus line). Of the above equipment, only the pineapple line has been operated. Some minor items of equipment are missing from the other lines but are expected to be ready for the 1983 season.

The plant is expected to operate 10 months per year. Fruit will be delivered as follows:

Pineapples: January to July  
Citrus: January to March  
Mango: March to July

Presumably the remaining 3 months will be devoted to reprocessing the mango juice stored in drums into 175 ml cans.

A large cold storage room (about 20 m x 20 m) will be used to store drums of juice, as well as fresh fruit if necessary.

The plant, if supplied with pineapple for a full 6 months and operated 6 days a week, should process 6,000 tons of fruit per season, single shift, or 12,000 tons on two shifts. This amount of fruit would be produced on roughly 100 ha and 200 ha, respectively. Remarks by the production staff of the plant seemed to indicate that SALGUIDIA would also ship fresh pineapple. This would account for the apparent excess amount to be produced by the plantation and local farmers.

#### 4. Sales

This past season SALGUIDIA produced 42,000 cases of pineapple juice during 2 months of operation (48 cans of 175 ml). About 25,000 cases of this are being held at the warehouse pending finalization of a sale to Libya. It is reported that a price of US\$12/case was agreed upon, which was US\$4 to US\$5/case above current world market prices.

The balance of the production was sold in Guinea. The product can still be found, with difficulty, in Conakry selling at S 25/can (official rate S 25 = US\$1). Some of it has been smuggled into Sierra Leone and can be found in Freetown.

#### 5. Observations

The enterprise appears to be well-equipped and well-organized. If it is allowed to maintain its freedom to export and import relatively free of controls, and if it benefits from a captive Libyan market, it should be a viable business.

PROFILE NO. 7

NAME: Société Nationale de Tomate Industrielle (SNTI)  
Périmètre de Dagana (SAED)  
LOCATION: Dagana, Sénégal  
DATE OF VISIT: 13 December 1982

1. General

This tomato operation is conducted by two state enterprises: SNTI operates the processing plant and SAED organizes tomato production by farmers at Dagana, as well as at other areas.

2. Raw Material Supply

The Director of the Dagana Perimeter, Mr. Malick, informed us that he and his staff of ten extension agents are working with about 15 families (60 persons) on a 2,000 ha block of land. Irrigation is by water pumped from the Sénégal River. He reports that this year 600 ha of tomatoes are being cultivated, and that yields should be between 20 and 25 tons/ha. Transplanting of seedlings takes place in October and November (end of the rainy season) and harvesting is done from January to April.

The area is divided into blocks delineated by irrigation canals, each block being assigned to a family, and the farmers are organized into cooperatives. Rice and tomatoes are the two main crops grown, though each family also has a vegetable plot. SAED assists farmers through extension services, tractor and rice harvester services, and sale of agricultural inputs on credit.

SAED's original objective in 1970 was to produce 50,000 tons of tomatoes at Dagana and at another site near St. Louis, and to supply the SNTI plant and the SOCAS (Société de Conserve Alimentaire du Sénégal) tomato plant near St. Louis. In fact, maximum production (in 1976) was 17,600 tons, of which only 10,220 tons were processed. Prices paid to farmers for tomatoes were too low relative to market prices. Large tonnages were sold fresh on the market at prices up to four times what the factory was paying. At Dagana last year, it is estimated that about one-quarter of tomatoes produced did not reach the factory for this reason.

The Dagana perimeter has also suffered from salinization due to encroachment of sea water up the Sénégal River. This has reduced yields of all crops. The problem should be overcome by the salt barrier dam being constructed at Diama. Shortage of manpower was also cited as a factor limiting production.

A 1980 study by a French consulting firm mentioned a number of other problems with SAED's operations: a bureaucracy too remote from the farmers and not enough involvement by farmers in decision-making, delays in cash payments to farmers, non-observance by farmers of planting schedules, irrigation works and maintenance poorly carried out, faulty irrigation practices, and poor maintenance of equipment (tractors, rice harvesters, etc.). While some of these problems may have been corrected in the interim, it seems clear that sufficient problems remain to prevent SAED from achieving its objectives.

### 3. Plant Operations

We visited the SNTI plant with the production manager, Mr. Iba Gaye. Constructed in 1978 and equipped with Italian-made machinery, it can handle 7 tons/hour of tomatoes, or 150 tons/day on a three-shift basis. In 1981, 5,000 tons of tomatoes were processed, which is less than 50 percent of capacity assuming a 2-1/2 month season.

Evaporating, sterilizing, filling, and closing machinery appears to be modern and in good condition. One line has an Italian filler which incorporates pasteurizing and can sterilizing on one piece of equipment. There are plans to add this year direct transfer of paste from the evaporators to the filling line, now done manually in carts.

Paste is canned in 820 gm, 2 kg, and 5 kg cans. The institutional market is important here since SNTI delivers a high proportion of its production to state institutions in the larger cans. Cans are purchased fully formed from the ELMAF Company in Dakar.

Wholesale prices for the paste currently average CFA 500/kilo, ex-factory. This price, which is presumably determined by actual costs rather than market factors, is 25 percent higher than costs at the Sinématiali plant in the Ivory Coast.

A problem experienced by the plant is delivery of immature and overripe fruit. An estimated 5 to 6 tons of fruit have to be discarded daily for this reason. Another problem has been a shortage of cases (plastic cases used by harvesters in the field -- like lug boxes). In fact, the SOCAS enterprise near St. Louis is able to purchase tomatoes

at Dagana because they do a better job of providing cases to farmers. The problem arises in part from the fact that too much fruit matures in a short space of time which overloads the collection system. This, in turn, is due to the failure of farmers to plant according to a fixed schedule, which would give a longer harvesting season.

The SOCAS operation is achieving better results because it supplies a portion of its needs from its own 120 ha plantation.

#### 4. Observations

Problems being experienced by this project appear to be related to a lack of coordination between production and processing on the one hand, and between farmers and the SAED extension agents on the other. The advantages of (1) strong central management and (2) tomato production at least partly under the control of the processor, are apparent from a comparison of the operations of SNTI and SOCAS.

APPENDIX B

OBSERVATIONS ON WEST AFRICAN TRADE

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Present Trade Patterns

A recent IMF study<sup>1</sup> examined trade patterns in ECOWAS countries. Nigeria accounts for two-thirds of all registered imports and exports -- almost all of which are with countries outside West Africa (primarily Europe). Exports are predominantly petroleum.

The second largest trader is the Ivory Coast, with 15 percent of total exports and 10 percent of total imports. It is followed by Ghana, with 6 percent of exports and 5 percent of imports; and by Sénégal, with 4 percent each of exports and imports.

Of the total amount of trade, less than 3 percent is accounted for by intraregional trade. The countries with the highest proportion of intraregional exports in their total exports are Sénégal (17 percent), Cape Verde (11 percent), Mali (9.7 percent), the Ivory Coast (4.4 percent), and Benin (3.9 percent).

Obviously, the sharing of a common currency (and language) accounts for the fact that there is considerable trade among members of the West African Monetary Union (WAMU).<sup>2</sup> It is interesting to note that the six WAMU countries, as a group, have greater than average intraregional trade. Although

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1. International Monetary Fund, Currency Convertibility in the Economic Community of West African States, Aug. 1982.

2. Sénégal, Togo, Ivory Coast, Upper Volta, Niger, and Benin.



numerous factors are at work here, this correlation suggests that a certain degree of economic integration fosters a trading mentality which carries over to trade with countries outside the community.

### Impediments to Trade

The reasons for the lack of trade among ECOWAS member countries are well known. The more obvious of them stem from arbitrary territorial boundaries imposed by the colonial powers, which in turn have created legal, language, and transportation barriers to trade. It is with the removal of these barriers that ECOWAS is now concerned.

More subtle and difficult problems have arisen from the existence of these barriers. These relate to the way individual states have chosen to manage their economies, their vulnerability to recent economic problems, and how they have dealt with these problems. Differences have arisen in the following areas:<sup>1</sup>

- . Economic planning and policy -- ECOWAS member countries range from centrally planned economies, through those where the government engages in macroeconomic planning only, to market economies where reliance is placed on the private sector and central planning is restricted to the relatively small public sector;
- . Monetary policy -- ECOWAS includes nonmarket countries where the central government exerts varying degrees of control over credit availability and interest rates, as well as market economies which rely more on indirect sectoral credit ceilings and guidelines and do not attempt to allocate the money supply; and

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1. This section draws heavily on the above-referenced IMF study.

Exchange and trade arrangements -- ECOWAS members range from countries with full or partial control over foreign exchange transactions (those with less than fully convertible currencies), to those with full convertibility and relatively few controls.

Apart from these basic differences, policies may vary with the state of the economy. Currently, exchange and trade restrictions exist in varying degrees in Nigeria, Ghana, Guinea, Guinea Bissau, Sierra Leone, and Mauritania.

Countries of the West African Monetary Union benefit from a currency convertible to the French franc. Trade among these countries is greatly facilitated as a result.

The question of immediate interest is the extent to which these policies and situations will affect inter-African trade in fruits and vegetables. In the long run, economic integration can only benefit member countries by reducing their vulnerability to deteriorating terms of trade. In the short run, however, nonconvertibility of currencies represents a serious barrier to trade. The West African Clearing House in Freetown offers a partial solution to these problems; unfortunately, relatively little use has been made of it to date.

#### West African Trade in Food Products

Trade in processed fruits and vegetables in West Africa consists almost entirely of imports from Europe. Very little inter-African trade occurs.

A recent ECOWAS report<sup>1</sup> noted the large amounts of food being imported into West Africa and predicted very large

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1. ECOWAS, Cooperation and Trade in Food Crop Products in the ECOWAS Sub-Region, ECW/TRAD/3, 1980.

demand. Average annual imports for the 1975-77 period (from FAO statistics) were as follows:

	<u>Imports (tons)</u>	<u>Value (US\$ millions)</u>
Wheat and wheat flour	1,234,700	245.1
Rice	594,900	199.3
Maize	138,900	23.7
Other	<u>199,600</u>	<u>31.0</u>
Total	2,168,900	499.1

The "other" category includes a large amount of sugar and other products, including preserved fruits and vegetables.

For the same 1975-77 period, total West African exports of food to the rest of the world were only 66,000 tons.

Food imports increased more than four times in the 10-year period from 1962-64 to 1972-74. Future growth will be related to population increases, and especially to the trend toward urbanization. The United Nations predicts a doubling of the population of West Africa between 1975 and the year 2000; urban population alone will increase 3.5 times. Especially in demand will be bread, rice, ready-made foods, fresh and canned fruits and vegetables, meat, and milk. Concomitantly, demand will decrease for traditional foods such as millet, sorghum, tubers, and plantains.

FAO and World Bank trade data for the 1974-76 period permit the grouping of ECOWAS countries by the value of food imports as a percentage of total export earnings:

B-5.

- . Sénégal, Mali, Benin, Upper Volta -- greater than 40 percent;
- . Sierra Leone, Gambia -- 31 to 40 percent;
- . Mauritania, Niger -- 21 to 30 percent;
- . Ghana, Togo -- 10 to 20 percent; and
- . Guinea, Nigeria, Ivory Coast, Liberia -- less than 10 percent.

Although the economic situation has changed since 1974, the above data indicate the urgent need of a number of countries to substitute local production for imports in order to avoid serious balance-of-payment problems.

Some idea of the type and level of trade among ECOWAS countries may be gained from Exhibit B-1. The data -- for five Francophone countries only -- shows the predominance of trade among these countries which share a common currency. Proximity is another determinant of trade level; Niger trades heavily with neighboring Nigeria, and Upper Volta trades with Ghana. The Ivory Coast is the most active trader; considerable trade is recorded with several countries which do not share a common border.

The most commonly traded vegetables at present include root crops (yams, sweet potatoes, cassava) and pulses (beans, peas), i.e., the less perishable items.

It was pointed out in the ECOWAS study that prospects for increased inter-African trade are limited because exported products (principally vegetable oil and oil seeds) are already produced in almost every country. Products which do appear feasible to develop for trade within the ECOWAS region include rice and fruits and vegetables, according to the study.

Exhibit B-1. Recorded Trade in Food Products Among  
Some Selected ECOWAS States, 1976

Country	Exported product	Value (000\$)	Exported mainly to
Ivory Coast	Pineapple juice	482	Sénégal (362), Mauritania (47)
	Fruit and nuts - prepared or preserved	306	Sénégal (207), Niger (76), Mauritania (23)
Upper Volta	Tropical fruit	193	Ivory Coast (126), Niger (67)
	Beans, peas	554	Ghana (352), Togo (105)
	Other fresh vegetables	288	Ghana (220), Ivory Coast (66)
Mali	Tropical fruit	64	Sénégal (48), Ivory Coast (16)
	Beans	169	Ivory Coast (169)
	Other fresh vegetables	152	Ivory Coast (151)
Niger	Beans	641	Nigeria (641)
	Other fresh vegetables	2,009	Upper Volta (1,213), Benin (599), Nigeria (165), Mali (32)
Sénégal	Potatoes	120	Mauritania (117)
	Other fresh vegetables	287	Mauritania (265)

Source: ECOWAS, Study of Recorded Trade Flows, ECW/TRAD/I, March 1978.

We concur with these findings as to trade in processed fruits and vegetables. In the current study, we have attempted to focus on projects which either draw on more than one country for raw or semiprocessed fruits and vegetables, or market their products in more than one country. The objective is to replace current imports (from outside the region) of processed fruits and vegetables by ECOWAS member states with local production in one or more countries. A secondary objective is to increase the exports of the region as a whole.

## APPENDIX C

### LIST OF PERSONS CONTACTED

APPENDIX C  
LIST OF PERSONS CONTACTED

Ivory Coast

1. M. Kasimir Gnacadjé, Factory Manager  
M. Anguille Henri, Field Manager  
Sinématiali Fruit and Vegetable Cannery
2. M. Bergman  
Director of Administration  
SAFCO  
Tiassalé
3. M. N'Da Isadore  
Assistant Director  
Operation Manioc (SODEPALM)  
Toumoudi
4. M. Kouakou Jacques  
Assistant Director  
Manioc Processing Factory (I2T)  
Toumoudi
5. Mr. Koffi Vincent  
Fruit and Vegetable Perimeter  
Koubi (Tiébissou)
6. M. Kouadio Yao  
Training Director  
Bouaké Experiment Station (SODEFEL)  
Bouaké
7. M. Jean-Xavier Grussenmeyer  
M. Plas  
Ivoirienne de Technologie Tropicale (I2T)  
Abidjan
8. M. Laurent Languey  
Chef de Cabinet  
Ministry of Agriculture
9. M. Boua Bouadou  
Director General  
SODEFEL  
Abidjan
10. M. Malan Ouatarro  
COFRUITEL  
Abidjan



Nigeria

1. Dr. W. E. Eguagie  
Assistant Director  
National Horticultural Research Institute  
Ibadan
2. Mr. H.G. Makhijani  
Mr. S.C. Chadda  
Vegetable and Fruit Processing Ltd.  
Lagos and Gombe
3. Mr. Ody Oniha  
Mr. Leonard Hill  
Mr. Jack Davenport  
U.S. Embassy  
Lagos
4. Mr. Adeyemo  
Lever Bros.  
Lagos

Sierra Leone

1. Mr. F. Cuthbert  
Mr. W. Samuels  
National Development Bank of Sierra Leone  
Freetown
2. Mr. U.J.H. Grieb  
FAO Resident Representative  
Freetown
3. Mr. Monteiro, Chief Technical Advisor  
Mr. M.A. Tunis, Small Industry Development  
UNIDO  
Freetown
4. Mr. Scarborough  
ACRE (Adaptive Crops Research and  
Extension) Project Officer  
USAID, Freetown
5. Mr. Momoh  
Deputy Development Secretary  
Ministry of Economic Planning  
Freetown

C-3.

6. Dr. Friedbert Reichhart, Director,  
Industrial Development Unit  
Mr. Eastman, Secretary General  
Mano River Union, Freetown
7. Dr. Rhodes  
Mr. Vernon Hall  
ACRE Project  
Njala

Mauritania

1. M. Bal  
Directeur des Douanes
2. M. Lame  
Direction de l'Agriculture
3. M. Carre  
Conseil Technique  
Direction de l'Agriculture
4. M. A. Tidjane Kane  
Division Maraîchage  
Ministère du Développement Rural
5. M. Chabaroun Cheick  
Division Maraîchage  
Ministère du Développement Rural
6. Mr. Ali Sy  
Division Maraîchage  
Ministère du Développement Rural
7. Mr. Diallo  
Vulgarisation et Production Agricole  
Ministère du Développement Rural
8. M. R. H. Goldman  
USAID Nouakchott
9. M. D. W. Carr  
USAID Nouakchott

C-4.

Benin

1. M. Joachim D'Almeida  
Director General  
SONAFEL  
Cotonou
2. M. Ahounou  
Director  
Horticultural Center  
Ministry of Rural Development  
Porto Novo
3. M. Bernard Adikpeto  
Director General  
Bureau Centrale des Projets  
Ministere du Plan  
Cotonou

Sénégal

1. M. Malick Samb  
Directeur du Périmètre de Dagana  
SAED
2. M. Iba Gaye  
Chef de Fabrication  
SNTI  
Dagana
3. M. Bakali  
Service Horticulture  
Ministère de l'Agriculture  
Dakar
4. Dr. Ousmane Kane, Director General  
Mme. N'Diaye  
Institut de Technologie Alimentaire  
Hann (Dakar)
5. Mr. Robert McAlister  
Mr. Lance Jepson  
USAID, Dakar

Guinea

1. M. Albert Sultan  
Director, Food Industries Division  
Ministry of Industry  
Conakry
2. M. Anjelo Camara  
Agro-Food Industries  
Ministry of Industry  
Conakry
3. M. Madessé Diallo  
Dir. Adjoint du Cabinet  
Cultures Industrielles et de l'Arboculturel  
Ministère de l'Agriculture  
Conakry
4. M. Ibrahim Kamille Camara, Representative du CEDAO  
M. Mamadou Souaré, Organismes Interafricain  
M. David Camara, Etats-Unis  
Ministère de la Coopération  
Conakry
5. le Director Adjoint  
SALGUIDIA  
Forécariah
6. M. Oua N'Diaye  
Institut de Recherches Agricole et  
Fruitières (INRA)  
Foulayah
7. M. Gouruessy Bah, Finance  
M. Fassoa Alexis Kurma, Recherche  
M. Magadi Massuma, Production  
Action Ananas Daboya (SECOFI)  
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## **APPENDIX D**

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